MOH/K/GIG/4-2023(BK)

ORAL HEALTH RESEARCH PRIORITIES IN MALAYSIA

ORAL HEALTH RESEARCH PRIORITIES IN MALAYSIA

e ISBN 978-629-98561-3-9
MOH Number: MOH/K/GIG/4-2023(BK)

First published in 2023

Oral Health Epidemiology & Research Section
Oral Health Programme
Ministry of Health Malaysia
Level 5, Block E10, Precinct 1
Federal Government Administrative Centre
62590 Putrajaya, Malaysia

Tel : +603-8883 4215
E-mail: ohd@moh.gov.my
Website : https://hq.moh.gov.my/ohp/index.php/ms/

Disclaimer
The details, views, interpretations, implications, conclusions and recommendations expressed in this document are those of the contributors alone and do not necessarily represent the opinions of the other investigators participating in the project nor the views or policies of the Ministry of Health Malaysia. All mistakes are solely the authors.

This report is published electronically on the website of the Oral Health Programme at **https://hq.moh.gov.my/ohp/index.php/ms/**

Table of Contents

FOREWORD

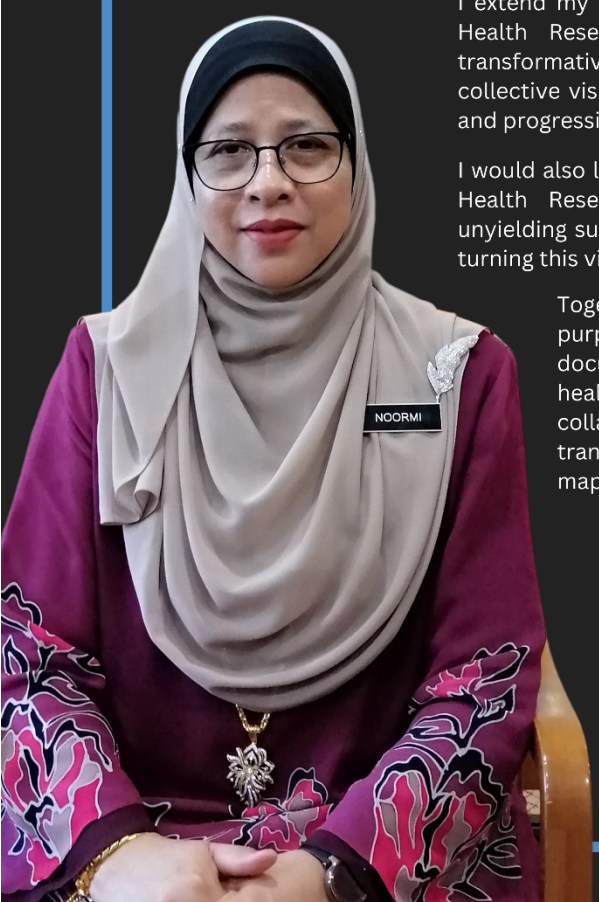
In the ever-evolving landscape of global healthcare, it is with immense pride and optimism that we present the Oral Health Research Priorities in Malaysia. This seminal document stands as a testament to our unwavering commitment to advancing oral health on a global scale, aligned with the vision set forth by the World Health Organization (WHO) Oral Health Resolution of 2021.

Grounded in evidence-based scientific research, the development of the 2022 global strategy and subsequent 2023 global action plan have provided us with a solid foundation. Embracing the WHO's call for "best buys" based on population health science, we embark on a journey to improve global oral health by translating research findings into tangible practices that deliver genuine clinical and public health benefits.

The significance of research cannot be overstated; it forms the bedrock upon which we build a healthier future for generations to come. As we lay out these oral health research priorities for Malaysia, we do so with a profound sense of responsibility to equip researchers and policymakers with the tools they need to create meaningful changes.

This document represents more than just a compilation of priorities; it symbolises a unified effort to strengthen collaboration across sectors in addressing oral health research challenges in our beloved nation. By fostering harmonious partnerships with diverse stakeholders, we fortify our collective resolve to confront the complex issues that lie ahead.

Our aspirations resonate deeply with the WHO's vision of an evidence-driven approach to enhancing global oral health. As we journey towards 2030, we are committed to evaluating our progress meticulously, guided by research findings to ensure accountability and adaptability.



I extend my heartfelt gratitude to the Technical Working Group on Oral Health Research for their unwavering dedication in shaping this transformative document. Their passion and expertise have elevated our collective vision, laying the groundwork for a more sustainable, equitable and progressive oral health landscape in Malaysia.

I would also like to express my sincerest appreciation to the National Oral Health Research Initiative (NOHRI) Executive Committee for their unyielding support. Their steadfast commitment has been instrumental in turning this vision into reality.

Together, as we forge ahead with determination and a shared purpose, I am confident that this Oral Health Research Priorities document will serve as a guiding light, illuminating the path to a healthier and happier Malaysia. Let us embrace the spirit of collaboration, innovation, and compassion as we embark on this transformative journey, leaving an indelible mark on the global map of oral health research.

DR. NOORMI BINTI OTHMAN
CHAIRPERSON
NATIONAL ORAL HEALTH RESEARCH INITIATIVE
(NOHRI) EXECUTIVE COMMITTEE

Advisors

Prof. Dr. Noor Hayaty binti Abu Kasim
Faculty of Dentistry
Universiti Kebangsaan Malaysia

Prof. Dr. Rosnah binti Mohd Zain
Faculty of Dentistry
MAHSA University

Prof. Dr. Zamri bin Radzi
Faculty of Dentistry
Universiti Malaya

Prof. Dr. Sharol Lail Sujak
Faculty of Dentistry
Manipal University College Malaysia

Secretariat

Dr. Habibah binti Yacob @ Ya'akub
Oral Health Policy and Strategy
Planning Division
Oral Health Programme
Ministry of Health

Dr. Suzana binti Sharif
Oral Health Policy and Strategy
Planning Division
Oral Health Programme
Ministry of Health

Dr. Nurulasmak binti Mohamed
Oral Health Policy and Strategy
Planning Division
Oral Health Programme
Ministry of Health

Dr. Nur Syuhada binti Abu Bakar
Oral Health Policy and Strategy
Planning Division
Oral Health Programme
Ministry of Health

Technical Working Group on Oral Health Research

Chairperson

Dr. Chia Jit Chie
Director
Oral Health Policy and Strategic Planning Division
Oral Health Programme, Ministry of Health

Technical Working Group Members

Dental Public Health

Dr. Marhazlinda binti Jamaluddin
Community Oral Health & Clinical Prevention Department
Faculty of Dentistry
Universiti Malaya

Colonel (Dr.) Normah binti Samsuri
Dental Specialists Polyclinic
Hospital Angkatan Tentera Tuanku Mizan

Assoc. Prof. Dr. Budi Aslinie binti Md Sabri
Dental Centre (Population Oral Health & Clinical Prevention)
Faculty of Dentistry
Universiti Teknologi MARA

Prof. Dr. Tuti Ningseh binti Mohd Dom
Department of Family Oral Health
Dental Public Health Unit
Faculty of Dentistry
Universiti Kebangsaan Malaysia

Assoc. Prof. Dr. Norkhafizah binti Saddki
Dental Public Health Unit
School of Dental Sciences
Universiti Sains Malaysia

Dr. Tan Ee Hong
Melaka Oral Health Division
Melaka State Health Department

Oral and Maxillofacial Surgery

Dr. Rifqah binti Nordin
Department of Oral and Maxillofacial Surgery
Faculty of Dentistry
Universiti Kebangsaan Malaysia

Dr. Kathreena binti Kadir
Department of Oral and Maxillofacial Surgery
Faculty of Dentistry
Universiti Malaya

Dr. Rosliza binti Parumo
Department of Oral and Maxillofacial Surgery
Hospital Sultanah Aminah
Johor Bahru, Johor

Brigedier Jeneral (Dr.) Sharifah Azlin Juliana binti Syed Zainal
Department of Oral and Maxillofacial Surgery
Hospital Angkatan Tentera Tuanku Mizan

Dr. Vimahl Dass a/l Paramanandam
Department of Oral and Maxillofacial Surgery
Hospital Pulau Pinang
Pulau Pinang

Paediatric Dentistry

Assoc. Prof. Dr. Farinawati binti Yazid
Paediatric Dentistry Unit
Faculty of Dentistry
Universiti Kebangsaan Malaysia

Colonel (Dr.) Zahani binti Mohamed Yussof
Dental Specialists Polyclinic
Hospital Angkatan Tentera Tuanku Mizan

Dr. Nurul Nazra binti Mohd Areffin
Department of Paediatric Dentistry
Hospital Tunku Azizah
Kuala Lumpur

Assoc. Prof. Dr. Annapurny a/p Venkiteswaran
Paediatric Dentistry and Orthodontics
Faculty of Dentistry
Universiti Teknologi MARA

Special Care Dentistry

Assoc. Prof. Dr. Mas Suryalis binti Ahmad
Dental Centre (Special Needs Dentistry)
Faculty of Dentistry
Universiti Teknologi MARA

Dr. Farah Natashah binti Mohd
Special Care Dentistry Unit
Faculty of Dentistry
International Islamic University Malaysia

Dr. Siti Zaleha binti Hamzah
Special Care Dentistry Unit
Hospital Kajang
Selangor

Dr. Maryani binti Mohamed Rohani
Special Care Dentistry Department
Faculty of Dentistry
Universiti Malaya

Dr. Norjehan binti Yahaya
Special Care Dentistry Unit
Hospital Kuala Lumpur
Kuala Lumpur

Oral Pathology and Oral Medicine

Dr. Nurshaline Pauline binti Hj. Kipli
Oral Pathology and Oral Medicine Unit
Hospital Umum Sarawak
Sarawak

Assoc. Prof. Dr. Zuraiza binti Mohamad Zaini
Department of Oral and Maxillofacial Clinical Sciences
Faculty of Dentistry
Universiti Malaya

Colonel (Dr.) Liana Ma binti Abdullah
Dental Specialists Polyclinic
Hospital Angkatan Tentera Tuanku Mizan

Dr. Norliwati binti Ibrahim
Department of Craniofacial Diagnostics and Biosciences
Faculty of Dentistry
Universiti Kebangsaan Malaysia

Dr. Fairuz bin Abdul Rahman
Oral Pathology and Oral Medicine Unit
Hospital Queen Elizabeth
Sabah

Forensic Dentistry

Assoc. Prof. Dr. Mohd Yusmiaidil Putera bin Mohd Yusof
Dental Centre (Forensic)
Faculty of Dentistry
Universiti Teknologi MARA

Dr. Nor Atika binti Md. Ashar
Department of Craniofacial Diagnostics and Biosciences
Faculty of Dentistry
Universiti Kebangsaan Malaysia

Dr. Hairuladha bin Abdul Razak
Forensic Dental Unit
Hospital Kuala Lumpur
Kuala Lumpur

Kapten (Dr.) Muhammad Noorazaam Farhan bin Mohd Sajalli
Academic Military Training
National Defence University of Malaysia

Dr. Noraliza binti Mohd Nor
Forensic Dental Unit
Hospital Pulau Pinang
Pulau Pinang

Orthodontics

Colonel (Dr.) Shalene a/p Kereshanan
Dental Specialists Polyclinic
Hospital Angkatan Tentera Tuanku Mizan

Dr. Mohd Zambri bin Mohd Makhbul
Orthodontic Specialist Unit
Klinik Pergigian Cahaya Suria
Kuala Lumpur

Assoc. Prof. Dr. Wan Nurazreena binti Wan Hassan
Orthodontic Department
Faculty of Dentistry
Universiti Malaya

Assoc. Prof. Dr. Alizae Marny Fadzlin binti Syed Mohamed
Department of Family Oral Health
Orthodontic Unit
Faculty of Dentistry
Universiti Kebangsaan Malaysia

Dr. Sindhuja a/p Rajadorai
Orthodontic Specialist Unit
Pekan Dental Clinic
Pahang

Periodontics

Dr. Yuhaniz binti Ahmad Yaziz
Periodontic Specialist Unit
Mak Mandin Dental Clinic
Butterworth, Pulau Pinang

Dr. Norul Husna binti Mohamad Hassan
Department of Periodontic
Faculty of Dentistry
Universiti Malaya

Dr. Khamiza binti Zainol Abidin
Periodontic Specialist Unit
Gunung Rapat Dental Clinic
Ipoh, Perak

Dr. Farha binti Ariffin
Dental Centre (Periodontology)
Faculty of Dentistry
Universiti Teknologi MARA

Colonel (Dr.) Zaharah binti Mahmud
Dental Specialists Polyclinic
Hospital Angkatan Tentera Tuanku Mizan

Restorative Dentistry

Dr. Kamarul Hisham bin Kamarudin
Restorative Dentistry Specialist Unit
Klinik Pergigian Kuala Lumpur
Kuala Lumpur

Colonel (Dr.) Mohamad Asri bin Din
Dental Specialists Polyclinic
Hospital Angkatan Tentera Tuanku Mizan

Dr. Roshima binti Mohd Sharif
Restorative Dentistry Specialist Unit
Klinik Pergigian Cahaya Suria
Kuala Lumpur

Assoc. Prof. Dr. Mariam binti Abdullah
Department of Restorative Dentistry
Faculty of Dentistry
Universiti Malaya

Assoc. Prof. Dr. Eshamsul bin Sulaiman
Department of Restorative Dentistry
Faculty of Dentistry
Universiti Malaya

Assoc. Prof. Dr. Nik Zarina binti Nik Mahmood
Dental Centre (Restorative Dentistry)
Faculty of Dentistry
Universiti Teknologi MARA

Oral Cancer

Dr. Hans Prakash a/l Sathasivam
Institute for Medical Research
National Institutes of Health
Ministry of Health Malaysia

Prof. Dr. Jennifer Geraldine Doss
Oral Cancer Research and Coordinating Centre
Faculty of Dentistry
Universiti Malaya

Dr. Nor Nazaliza binti Basri
Oral Pathology and Oral Medicine Unit
Hospital Kuala Lumpur
Kuala Lumpur

Dr. Hoe Ai Sim
Department of Oral and Maxillofacial Surgery
Hospital Seberang Jaya
Pulau Pinang

Dr. Sherrie Chong Mei Yee
Department of Oral and Maxillofacial Surgery
Hospital Tengku Ampuan Rahimah
Klang, Selangor

Dr. Shim Chen Kiong
Department of Oral and Maxillofacial Surgery
Hospital Umum Sarawak
Kuching, Sarawak

Executive Summary

Investing in oral health research is critical, as highlighted in the fifth priority area under the National Oral Health Policy. The prioritisation of research within the National Oral Health Policy has demonstrably encouraged the investigation of oral health issues, yielding evidence-based approaches for patient care and management as well as contributing to the programmes planning and monitoring. Realising the importance of research in assisting researchers and policy makers, this document on Oral Health Research Priorities in Malaysia was initiated by the National Oral Health Research Initiative Executive Committee.

The prime objective of outlining the Oral Health Research Priorities in Malaysia is to drive research activities to produce relevant data and evidence to support the primary goal of oral health sector. It is also crucial to lessen the critical knowledge gap to address national problems. The research outputs should further improve the oral health status and the oral healthcare delivery in Malaysia. The priority setting exercise was carried out by the Technical Working Group on Oral Health Research Priorities and it also involved the representation of stakeholders from National Oral Health Research Initiative Executive Committee in order to gather comprehensive input.

Individuals as well as oral healthcare organisations embarking on research are encouraged to use these research priority areas to design and shape their future research proposals. These research priorities are not only relevant to the Ministry of Health, but it also intended for all the other institutions that conduct oral health researches in Malaysia – the public and private universities, Ministry of Defense, non-governmental organisations (NGOs), oral health industry as well as dental students.

This document identifies seven (7) research priority domains and a variety of research scopes as detailed in **Table Executive 1**.

Table Executive 1: Oral Health Research Priorities in Malaysia

Research Priority Domain	Sub-domain	Research Scope
Oral Health Condition	**High burden of oral diseases**	Dental caries, Early Childhood Caries (ECC) & severe Early Childhood Caries (sECC) and treatment needs
	Lack of national data	Periodontal medicine
		Peri-Implant diseases
	Late detection of disease	Measures for early detection of periodontal and peri-implant disease
	High impact of oral lesion	Oral mucosal disorder
		Osteonecrosis (ORN) and Medication Related Osteonecrosis of the Jaw (MRONJ)
	Impact of oral condition	Malocclusion and treatment needs
		Cranio-dentofacial anomalies
		Outcomes of orthodontic treatment
		Orofacial pain and treatment needs
		Orofacial dental trauma and treatment needs
		Molar-Incisor Hypo-mineralisation (MIH)
	High mortality & morbidity associated with oral cancer and inadequate local data on oral potentially malignant disorders (OPMDs)	Assessment of oral cancer literacy and uptake of cancer prevention strategies
		Evaluation of the economic impact of oral cancer and OPMDs from the perspective of society
		Evaluation and provision of evidence to strengthen the existing national HPV immunisation programme
		Provision of evidence for the development of oral cancers prevention programmes based on known general and specific risk factors
		Assessment of the aetio-pathogenesis of oral cancer to assist in prevention
		Exploration of the underlying phenomenon of delayed diagnosis and treatment amongst oral cancer patients in Malaysia

Research Priority Domain	Sub-domain	Research Scope
		Improve early detection of oral cancer & oral potentially malignant disorders (OPMDs)
		Identification & validation of predictive and prognostic clinico-pathological features & biomarkers for companion diagnostics for oral cancer and OPMDs
		Treatment and management
		Rehabilitation and survivorship
	High oral disease burden of target groups	Oral health condition of special children
	High oral disease burden among patients with special health care needs	Oral health status/ oral disease burden and treatment needs of adults with special needs
		Impacts of oral diseases on quality of life of the different groups of adults with special needs
	High percentage of dental fear and anxiety	Dental fear and anxiety in children and adolescents
		Validation of dental anxiety scale
	No standard treatment needs index for all parties	Dental caries
		Treatment needs / demands
		Gerodontology
	Mandibular full denture dilemma	Oral Health Quality of Life
	Low readiness towards 4IR in perio-endo lesion	Oral Health Quality of Life
Public Oral Health Intervention and Empowerment	**Oral health intervention study**	Evaluation of oral health interventions
		Developing new interventions using more current approach or method
	Low empowerment of Malaysian population	Oral Health Literacy study

Research Priority Domain	Sub-domain	Research Scope
	Lack of empowerment for patients with special health care needs and their caregivers on self-care/ personal oral health care	Development of oral health protocols /guidelines for: a) Adults with special needs b) Elderly people
Access to Oral Healthcare	**Utilisation of oral healthcare services of the population / target groups**	Evaluation of oral health services
		Utilisation & barriers of oral healthcare services by types of services (primary care & specialist care services) and target populations
		Provision & sustainability of oral healthcare to ensure dental fitness in Malaysian Armed Forces (MAF)
		Evaluation of the perceptions of oral health services among adults with special needs/ their caregivers in Malaysia of dental services
		Evaluation of utilisation of oral healthcare services among adults with special needs in Malaysia
		Illegal dentistry / false demand (fake braces) / Traditional Complimentary Medicine (TCM)
		Access and delivery of services to vulnerable or disadvantaged population
		Impacts of changes in oral healthcare delivery (outreach programmes)
	Oral health inequalities	Study of oral health inequalities at a community
	Access to care (Orthodontics)	Prioritising treatment needs
	Oral health resources	Human resources/ oral health workforce
		Economics of oral healthcare
		Occupational health-related problems
		Ethics in dentistry

Research Priority Domain	Sub-domain	Research Scope
Traditional and Complimentary Medicine (TCM) in Oral Healthcare	**High percentage of orofacial pain and oral diseases**	Explore use of TCM as additional treatment tool in managing patients with orofacial pain
		Therapeutic and preventive potential of local herbs and their mechanisms in oral disease/ conditions
	High mortality & morbidity associated with oral cancer	Explore the use of TCM amongst patients with oral cancer
Oral Tissue Engineering (OTE) and Regenerative Dentistry	**Readiness towards National 4IR Policy - advanced materials and technology in healthcare**	Regenerative dentistry / oral tissue engineering
		Genetic and profiling studies on key biomarkers and pathogenic microorganism in health and diseased periodontium
	Lack of national study	Regenerative endodontics
		Clinical trials – bone defects, stem cells or new biomaterial investigation
ICT Support Systems for Oral Healthcare (Information & Communication Technology)	**Readiness towards 4IR**	Teleconsultation
		Potential use of teleconsultation for diagnosing and early intervention of mucosal lesions.
		Development and validation of AI framework in oral pathology
		Evaluation of needs, acceptance and effectiveness of teledentistry service in Special Care Dentistry
		Oral health data governance
		Digital dental age assessment methods in forensic odontology
		Digital bitemark analysis of forensic concern
		Feasibility of non-ionising 3D scanning in national and international ID process
		Non-ionising modalities for oral and maxillofacial diagnosis
		Stereolitography and rapid prototyping using Cone Beam CT 3D reconstruction

Research Priority Domain	Sub-domain	Research Scope
Digital Technologies in Dentistry	**Utilisation of technology**	Feasibility and application of digital pathology (DP) in oral pathology practice
		Investigations and diagnoses
		Fabrication of prostheses
		Orthodontic radiology
		Antemortem dental records archives
		Anthropological/ morphological analysis of teeth and skull

Introduction

1. Background

The Oral Health Programme, Ministry of Health Malaysia is entrusted to ensure the development of the national oral health policy and plan, the operation of the oral healthcare programme, legal activities and enforcement of practice and the oral health development is always improved and delivers customer satisfaction as well as meeting stakeholder's expectations requirements. Fulfilling these responsibilities has become more challenging in the recent years. Demands for oral healthcare services have grown exponentially as a result of ageing population, rising prevalence of dental caries and periodontal diseases as well as various threats from illegal dental activities. Costs of dental materials and technologies have also continued to rise. Health budget, however, has not increased proportionately thus this condition create the need to optimise available resources.

Oral health has been documented as equally important as general health. Moreover, knowledge about oral health has been regarded as an important factor that determines overall health. It affects physical, psychological and social well-being of a person. Oral health services and personnel play vital roles in efficient service delivery to safeguard equitable and timely access to oral health treatments. Although dentistry is always viewed as professional practice, it is also a science that depends on the researchers to develop new and better dental technologies. These dental technologies will be delivered to the general public through the training of dental practitioners. Researches has also become an integral part of oral health services to keep pace with increasing demand for evidence and information to inform oral healthcare decisions and policies and to continuously improve the quality of services provided for the population. Researches could generate innovative ideas and bring about transformation in service delivery in line with the changing demands of the population and the advancement of digital technology.

The culture of conducting research in oral health services has progressed at a faster pace in the recent years. A large number of small-scale researches are being conducted at hospitals and health facilities by both experienced

and young oral health researchers, who sometimes repeat similar researches in different facilities. In contrary, very few researches are conducted on a large-scale basis or nationwide to address critical national oral health concerns. There are still many areas of oral health research yet to be explored.

Proper research planning and guidance in research setting are pivotal in order to avoid incoherence and also to address the current and critical evidence gaps. Therefore, there is an urgent need to streamline the research processes for the dental fraternity in Malaysia. The areas of research need to be systematically identified. It needs to focus on impactful topics and initiate the decisions made which aligned with the National Oral Health Strategic Plan 2022 – 2030.

Oral health research priorities setting is critical in bridging the knowledge gap, maximising the resources and supporting the development of new policies. The executive committee of National Oral Health Research Initiative (NOHRI) recognised the fundamental need to set priorities in oral health research. This recognition helps to streamline the oral health researches in building a relevant and useful body of evidence and knowledge that can support decision-making and policies review and subsequently improve oral health services delivery to the population.

2. Objectives

The document on Oral Health Research Priorities in Malaysia is developed to provide evidence-based and well-planned guidance in conducting oral health research in line with the National Oral Health Policy. The specific objectives of setting the oral health research priorities are:

i. To guide researchers embarking on oral health research projects that can provide information and evidence to support the primary goals of the 12th Malaysia Plan, Ministry of Health Strategic Plan 2021 – 2025 and National Oral Health Strategic Plan 2022 – 2030;
ii. To generate useful evidence for policy makers in charting new directions or policies in oral health and health services;

iii. To streamline conventional individual research projects towards national researches that are able to address national health priorities; and
iv. To optimise the time, effort and resources for oral health research.

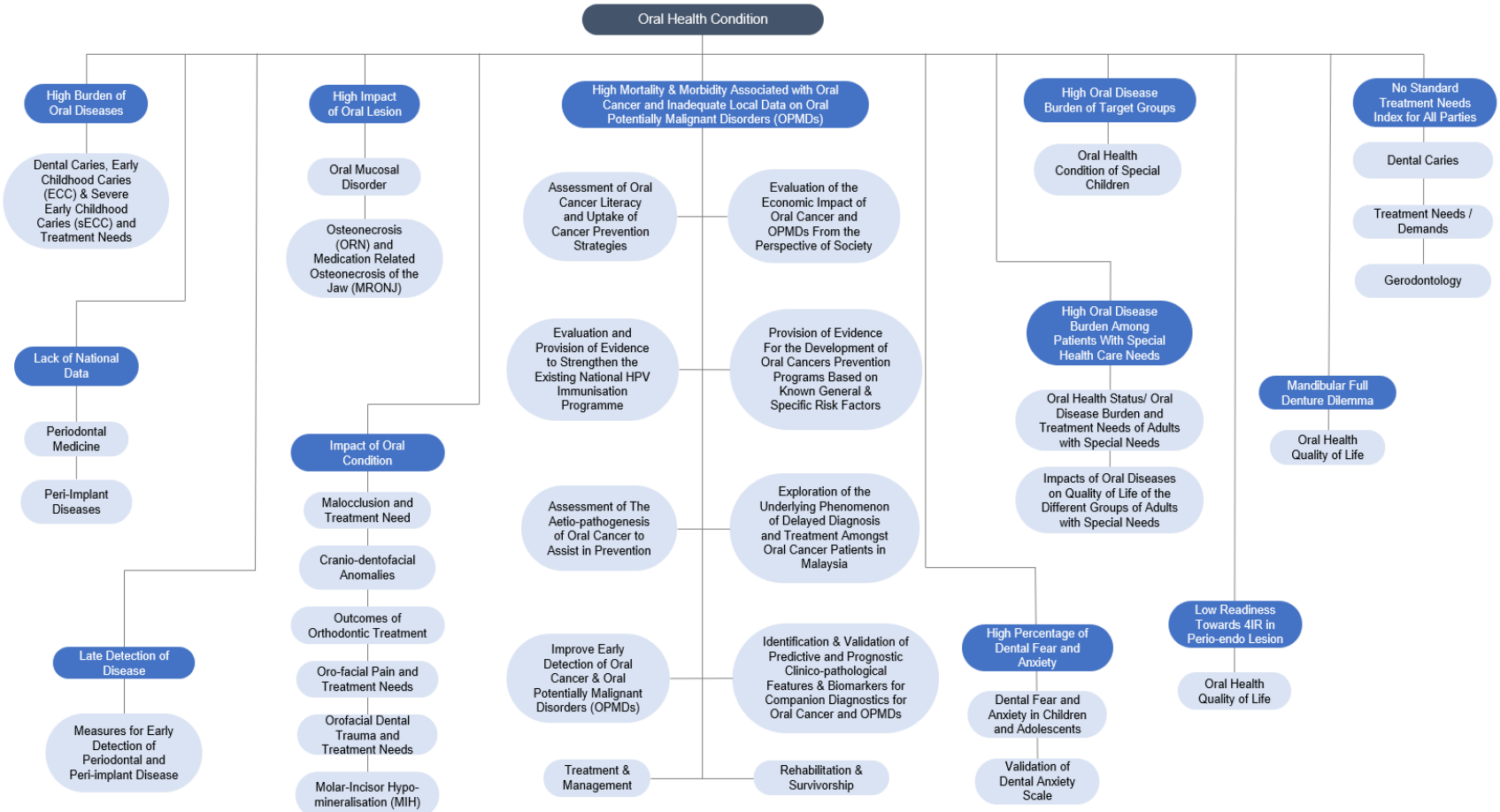
3. Methodology

Setting the oral health research priorities has been one of the main agenda of the National Oral Health Research Initiative (NOHRI) Executive Committee since 2019. This Executive Committee is the prime committee who are actively engaged with research activities in their own institution. This committee is deemed capable of providing holistic and cross-departmental view of oral health research activities and needs within the dental fraternity in Malaysia. It is chaired by the Principal Director of Oral Health, Ministry of Health Malaysia. The members consists of the head of Oral Health Section, Health Services Division, Ministry of Defence Malaysia, Deans of all Dental Faculties in Public and Private Universities and Senior Group Leader, Head and Neck Cancer Research, Cancer Research Malaysia. The Technical Working Group is chaired by the Director of Oral Health Policy and Strategic Planning Division of the Oral Health Programme MOH who is responsible to drive and implement the project as well as to monitor the timeline by which key milestones are to be achieved. The members of Technical Working Group on Oral Health Research are listed in page iii to viii. Several meetings were conducted during the initial brainstorming and this was done separately according to each oral health specialties/ disciplines. It was then reassembled into eight (8) domains. This document was presented and approved during the National Oral Health Research Initiative (NOHRI) Executive Committee meeting held in 2022. Upon approval of this document, seven (7) domains were accepted. A total of four (4) members from the National Oral Health Research Initiative (NOHRI) Executive Committee were appointed as Advisors to help assist in refining this document.

DOMAIN 1

ORAL HEALTH CONDITION

Framework for Domain 1: Oral Health Condition



Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
1. High burden of oral diseases	1. Dental caries, early childhood caries (ECC) & severe early childhood caries (sECC) and treatment needs: a) Disease burden; b) Health economics of oral disease; c) Treatment associated with dental caries; d) Oral health status of toddler, pre-school children and school children;	**Changes in disease patterns** 1. Periodical monitoring of oral diseases and oral lesions by different target populations is crucial to reflect changes in disease patterns due to demographic changes over time and impacts on oral health programmes. (e.g.: Continuity of National Surveys and the first big oral health survey among Military Armed Forces (MAFOHS) was in 2011). 2. Mapping or visualisation of oral diseases burden would facilitate oral health planning, such as distributing human and health financing including financial resources and patient paying mechanism to suit the need of the population and address the most in need groups. 3. Projection data on oral diseases pattern would	1. Epidemiological study on dental caries, ECC & sECC and treatment needs among all target groups in Malaysia: a) Barriers for dental treatment of different income groups; b) Children's feeding practice & dietary consumption of sugary and unhealthy foods. 2. Periodical monitoring through Digital Dentistry: Dental Readiness Management System (DRMS). 3. GIS mapping to visualise the burden of dental caries, ECC & sECC and treatment needs in different target groups	1. Data on disease burden and treatment needs including trend over time. 2. Predictors/ associated factors to dental caries & s-ECC. 3. Data of disease burden for oral healthcare financing/ health economics. 4. Improvement of caries prevention programmes and control of risk factors for ECC, and methods to raise public awareness. 5. Development of preventive management guide for GDP and dental nurses.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
1. High burden of oral diseases (con't)	1. Dental caries, ECC & sECC and treatment needs: a) Disease burden; b) Health economics of oral disease; c) Treatment associated with dental caries; d) Oral health status of toddler, pre-school children and school children; (con't)	facilitate oral health planning on policy, resources and implementation of services. 4. The only available national data for childhood caries is among 5-years-old with no demarcation between ECC and s-ECC. Untreated ECC can progress to sECC, which can lead to pain, emergency visits and hospitalisation due to spreading of infection.[1] 5. The cost of treatment may increase, especially for general anesthesia (GA). 6. A common treatment strategy for children with ECC is GA, especially when behaviour, anxiety, age or medical status prohibits treatment in the dental clinic setting.[2] During the COVID-19 pandemic, most hospitals are functioning at substantially reduced capacity, which translates to an ever-lengthening waiting	according to regions, socio-economic indicators (household income, education level, occupation, area deprivation index, etc). 4. Time-series and projection (modelling) of different oral diseases burden among different target population over time. 5. Impacts of dental caries, ECC & sECC and treatment needs on quality of life in all target groups. 6. Outcome of care for all target groups. 7. The possible predictors in high-risk groups and impact on lifestyle.	6. GIS mapping of oral disease showing hotspot areas, etc. 7. Projection of diseases over time. 8. Quality of life data as impacts of oral diseases and oral health programmes. 9. Burden of oral disease on the general anaesthesia in the hospital setting. 10. Impact of ECC rehabilitation under GA on Oral Healthy Related Quality of Life (OHRQoL). 11. Financial burden, type of resources and average cost of treatment under GA.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
1. High burden of oral diseases (con't)	1. Dental caries, ECC & sECC and treatment needs: a) Disease burden; b) Health economics of oral disease; c) Treatment associated with dental caries; d) Oral health status toddler, pre-school children and school children; (con't)	list for dental treatment under GA. Being left untreated, dental caries can progress into pain and infection. According to the Malaysian National Data for the Specialty of Paediatric Dentistry, in the year 2019 and 2020, more than 60% of GA sessions for paediatric dental surgery were allocated to treat caries. It is important to have data on caries treatment under GA. This data would help in strengthening the oral healthcare services in children at secondary and tertiary levels. 7. Systematic review by Crystal and Niederman found that in 2019, silver diamine fluoride (SDF) is effective in arresting decay in primary teeth with proportion of arrested caries ranges from 66% to 81% with annual or biannual	8. Economic evaluation on provider cost, patient cost and economic burden in caries management for children both in clinic and hospital settings. 9. Randomized control trials study on the preventive management or interim therapeutic management for controlling dental caries, ECC & sECC. 10. Dental GA: a) Prevalence of cases require comprehensive dental treatment under GA due to ECC in Malaysian hospitals; b) Prevalence of caries recurrence after	12. Rate of caries arrest at 6 months and 12 months post-application compared to sodium fluoride (NAF) varnish. 13. Data on the urgent care due to pain and infection while waiting for dental treatment under GA. 14. Development of caries preventive protocol using SDF in healthy or special needs children.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
1. High burden of oral diseases (con't)	1. Dental caries, ECC & sECC and treatment needs: e) Disease burden; f) Health economics of oral disease; g) Treatment associated with dental caries; h) Oral health status toddler, pre-school children and school children; (con't)	application.[3] The use of SDF in children awaiting for long-list CDT under GA may prevent progression of caries, pain and infection.	comprehensive dental treatment under GA; c) Cost effectiveness analysis or cost benefit analysis of dental treatment under GA; d) OHRQoL before and after dental GA. 11. Silver Diamine Fluoride (SDF): a) Randomized controlled trial to investigate the effectiveness of SDF in caries prevention compared to NAF varnish in preschool children (Community level); b) Investigate the effectiveness of SDF in preventing dental pain and infection in children awaiting	

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
1. High burden of oral diseases (con't)			dental treatment under GA (secondary/ tertiary level); c) Knowledge, attitudes and perception on SDF used in controlling caries and hypersensitivity among dental personnel.	
	1. Dental caries, ECC & sECC and treatment needs: i) Risk & protective factors/ predictors/ associated factors/ parental factors/ environmental factors;	1. To provide high ranking local evidence on risk factors, predictors, associated factors of oral diseases, lesions and conditions in different target populations in Malaysia. For example: - Data on smoking and military life is essential due to high percentage of smokers in Military Armed Forces (MAF) due to military working condition;	1. Systematic review and meta-analysis of association between oral diseases, lesions and risk factors, predictors, parental factors, associated factors among different target groups. 2. Prospective studies on risk factors of oral diseases & conditions (protective factors &	1. Data to facilitate planning of oral health programmes, including health prevention and promotion. 2. Tackling the common risk factors in the multidisciplinary approach. 3. Identification of social capital strategies to

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
1. High burden of oral diseases (con't)	1. Dental caries, ECC & sECC and treatment needs: i) Risk & protective factors/ predictors/ associated factors/ parental factors/ environmental factors; (con't)	- Consumption of sugar intake, nutrient intake, nutritional status and prevalence of dental caries is increasing in Malaysia; - New pattern of dietary intake among younger generation; - Consumption of fruits and milk intake. 2. Prospective data on these determinants will be useful for planning of oral health prevention and promotion programmes. 3. To provide more evidence on common risk factor to foster collaboration common risk factor approach with medical counterparts.	risk habits, socio-behavioural, moderators, mediators) using path analysis and structural equation modelling. For example: - Social-pathway for oral diseases/ stress; - Role of strengthening social capital (individual and community) as a protective factor for oral disease (perio & oral cancer outcome); - Diet intake (frequency, pattern) & oral health among various populations. 3. Risk estimation modelling the risk factors and predictors of oral diseases and oral	improve prognosis/ outcome. 4. Modelling of predictors associated with oral health outcomes of adults with special needs.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
1. High burden of oral diseases (con't)			disease risks in general and at-risk populations. 4. Combined research with medical counterpart in Military Medicine Department (Jabatan Perubatan Tentera), common risk factors. 5. Clustering behaviours studies among different target populations.	
	1. Dental caries, ECC & sECC and treatment needs: ii) Relationship between oral diseases and systemic diseases; iii) Anthropometric measurements (BMI – obesity, overweight,	1. Evidence on relationship between oral diseases and systemic diseases is still lacking in Malaysia. Data on this is essential to plan common risk factor approach interventions or programmes. 2. To provide evidence to prevent complications of	Studies to investigate association between oral diseases and systemic diseases. For example: - Bi-directional relationship between periodontal and systematic diseases- from the point of awareness of medical personnel/ public /dental personnel;	1. Evidence to put value of oral health into general health. 2. Evidence to support multidisciplinary approach.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
	underweight) and dental caries among children and adults.	chronic diseases by early detections of oral diseases.	- Anthropometric measurements and dental caries among children and adults.	
2. Lack of national data	1. Periodontal Medicine - Relationship between periodontal disease & systemic diseases and associated risk factors.	1. High national prevalence of periodontal disease and with increasing trend of: • 12-year-old – 99.6% Gingivitis (NOHSS 2017); • 15-19 years old – CPI 4: 0.3% (NOHSA 2000); 3.0% (NOHSA 2010); • Adults- CPI 4: 5.2% (NOHSA 2000); 18.2% (NOHSA 2010); • All range of periodontal disease in adults: 85% (2000) to 94% (2010). 2. Malaysian data on prevalence of periodontal disease currently not available for patients with: • Diabetes Mellitus; • Obesity;	1. Prevalence studies among targeted Malaysian population. a) Population-based epidemiological study; *by inclusion of variables within NOHSA 2020 • Body Mass Index (BMI); • Waist measurement; • Medical history – Diabetes, RA. b) Other prevalence studies. 2. Clinical research studies on periodontal disease among patients with: a) Diabetes;	1. Prevalence data on periodontal disease among targeted Malaysian population. 2. Provision of evidence to facilitate National Oral Health Plan (NOHP) planning for more effective strategies and realistic implementation for control and early intervention of risk factors associated with periodontal disease (i.e., diabetes, obesity, RA). 3. Facilitating and providing evidence for systematic and

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
2. Lack of national data (con't)	1. Periodontal Medicine - Relationship between periodontal disease & systemic diseases and associated risk factors. (con't)	• Rheumatoid Arthritis (RA). 3. Malaysian data on the bi-directional relationship between Periodontal disease and diabetes currently not available. 4. 49% of Malaysian with diabetes had never been examined or diagnosed (NHMS 2019). Possible role of dentist / periodontist in the detection of undiagnosed diabetes using periodontal parameters in patients attending periodontal clinic. 5. Increase need for public awareness of the link between systemic diseases and periodontal diseases and the benefits of periodontal treatment.	b) Obesity; c) Rheumatoid Arthritis. *To explore the feasibility of collaborative studies with medical fraternity – examples: NHMS 2026, Diabetic Clinics, Medical Specialists. 3. Studies investigate diagnostic tools using periodontal parameters for the detection of undiagnosed diabetes. 4. Survey research studies. 5. GIS mapping representing the burden of oral diseases in adults with periodontal disease across the country.	comprehensive collaboration between medical and dental fraternity to produce guidelines for referrals and co-management. 4. Provision of evidence to facilitate national strategies for collaborative promotional and preventive programmes.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
2. Lack of national data (con't)	2. Peri-implant diseases	1. Studies have shown the prevalence of peri-implant diseases has an increasing trend parallel to the increasing number of dental implants being placed daily. 49.5% of adult population in Malaysia requires prostheses (NOHSA 2010). Many dental professionals place dental implants as a main option for replacing missing tooth. 2. Malaysian data not available for: • Prevalence of peri-implant diseases; • Success/ survival rates of dental implants; • Number and types of dental implants commonly used. 3. Increasing difficulty in managing peri-implant complications (peri-implant diseases, prosthetic failure,	1. Prevalence studies of peri-implant diseases in Malaysia: a) Population-based epidemiological study by inclusion of variables within NOHSA 2020; • Number of dental implants; • Peri-implant probing. b) Other prevalence / success / survival rates studies. 2. Survey research studies on targeted population. E.g.: General Dental Practitioners/ institutions a) Practice of dental implant therapy; b) Knowledge, Attitude, Practice (KAP).	1. Provision of evidence to facilitate: i. National strategies for collaborative promotional, preventive and treatment programmes; ii. Planning of future training needs among Periodontal Specialist in managing peri-implant complications. 2. To facilitate future plans such as the development of dental implants registry. 3. Provision of evidence to facilitate the production of Clinical Practice Guidelines in maintaining dental implants.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
		etc.) due to problems in tracing of the history of implant placement to facilitate management. 4. Dental practitioners need to be aware of the importance and benefits of regular maintenance of dental implants.		
3. Late detection of disease	Measures for early detection of periodontal and peri-implant disease.	1. Late detection of periodontal and peri-implant disease causing early tooth / implant loss have a negative impact on quality of life and increase cost for rehabilitation/ treatment. 2. Alternative measures are needed to facilitate early detection.	1. Artificial intelligent studies for early detection of periodontal/ peri-implant disease leading to development of detection kits. 2. Innovation and invention studies to create prototypes – validation studies – randomised clinical trials.	1. Facilitating innovation and development of detection kits as an alternative to conventional diagnostic measures. 2. Production and commercialisation of disease detection kits.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
4. High impact of oral lesion	1. Oral mucosal disorder. Immunologically mediated ulcerative disorders.	1. Insufficient national data available on these quite common but life-threatening disorders. 2. Poor utilisation of proper standardised evidence-based intervention. 3. Insufficient data on lesion related neoplasm like paraneoplastic pemphigus.	1. Epidemiological study of Malaysian population. 2. New technology on chairside and/ or laboratory diagnosis. 3. Dental education module to improve awareness, clinical diagnosis and management of these lesions. 4. Evidence-based intervention studies.	1. Data on disease burden for health planning, treatment needs and financing. 2. Predictors of disease outcome. 3. Provide protocol to improve management of lesions.
	2. Osteonecrosis (ORN) dan Medication Related Osteonecrosis of the Jaw (MRONJ).	No establish national data for ORN and MRONJ.	1. Epidemiology study. 2. Efficacy of treatment. 3. Disease predictor via AI model.	National data on ORN and MRONJ.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
5. Impact of oral condition	1. Malocclusion and treatment needs.	1. Class I, II &III. 2. Skeletal pattern Class I, II, III. The demand for orthodontic treatment is ever increasing. In developed countries, mainstream orthodontic treatment is largely provided by qualified orthodontists. In Malaysia, many patients seek orthodontic treatment from General Dental Practitioners in the private sector. In their state of urgency, some individuals may be compelled to pursue treatment from unauthorized practitioner. There is low 4IR readiness of schoolchildren with Class I, II, III incisor relationships & skeletal pattern. Basic dentofacial characteristics have been long available for other nations/ populations (Eg; Caucasian, Asian, Chinese, African, Indian etc). Information on malocclusion in order to estimate the total need for treatment in addition to the IOTN[4] (Index of Orthodontic Treatment Need):	1. An epidemiological study for Malaysian population. 2. OHRQoL studies. 3. Outcome of care. 4. GIS mapping to visualise the burden of malocclusion and treatment need in different target groups according to regions, socioeconomic indicators (household income, education level, occupation, area deprivation index, etc).	1. Estimation of the total need for orthodontic treatment: a) Human resource; b) Training; c) Costs; d) Health financing; e) Facilities. 2. Estimation of the environmental and hereditary causes of the various elements in the aetiology of malocclusion of Malaysian school children. 3. Effect of malocclusion and skeletal growth on sleep apnea: a) screening policy; b) orthodontic treatment approach; c) establishing a designated team

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
5. Impact of oral condition (con't)		a) Plan & facilitate the preventive/ treatment measures required; b) Planning proper healthcare programmes & resources (human resource, budgeting etc); c) A legitimate exploration tool for recognising the environmental and hereditary elements in the aetiology of malocclusion.		for holistic management. 4. Orthognatic Surgery (OGS): OHRQoL.
	2. Cranio-dentofacial anomalies: a) Hypodontia and treatment needs;	Hypodontia can be defined as the developmental absence of one or more teeth excluding the third molars. The severity of hypodontia can be categorised as: - Mild: 1–2 missing teeth - Moderate: 3–5 missing teeth - Severe: 6 or more missing teeth. The gold standard of care for hypodontia cases is through a multidisciplinary team approach.[5] The prevalence of hypodontia[6] has been reported to be between 4.6–6.3% within the permanent dentition of white European populations; 3.2–4.6% in white North Americans; and 6.1–7.7% in Chinese. Females tend to be more affected than males	1. Epidemiology study on the prevalence and severity of hypodontia in Malaysia. 2. Clinical management - the best practice for Malaysia. 3. QoL of hypodontia patients - physical, psychological and social impact. 4. GIS mapping to visualise the burden of malocclusion and treatment need in different target groups	1. Establishment of centres of excellence at regions that have the highest prevalence of hypodontia to facilitate improved multidisciplinary team management. 2. National taskforce for General Dental Practitioner guidelines on management of hypodontia cases. 3. To better understand the genetic basis of

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
5. Impact of oral condition (con't)	2. Cranio-dentofacial anomalies: a) Hypodontia and treatment needs; (con't)	and the type of teeth most frequently affected are lower 5's followed by upper 2's, upper 5's and lower 1's. Hypodontia is a feature in many syndromes including ectodermal dysplasia, Down syndrome, Orofacial digital, Ellis-van Creveld, Ehler's Danlos. Non-syndromic or familial hypodontia occurs as an isolated trait. Syndromic hypodontia occurs with accompanying genetic disease. In Malaysia, 4IR readiness on the complexity and distribution of hypodontia of our population is weak. In a retrospective study of 451 patients with hypodontia, the most common patient complaints included spacing between the teeth, poor aesthetics and awareness of missing teeth. Delayed referral of the patient is likely to have a negative impact on the social and educational development of these patients[7]. Hypodontia carries an aesthetic, functional, psychosocial and financial burden for affected individuals.	according to regions, socioeconomic indicators.	hypodontia in the Malaysian population.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
5. Impact of oral condition (con't)	2. Cranio-dentofacial anomalies: a) Hypodontia and treatment needs; (con't)	Patients with missing permanent teeth may suffer from complications such as malocclusion (which itself can lead to mastication problems), periodontal damage, lack of alveolar bone growth, reduced chewing ability, inarticulate pronunciation, changes in skeletal relationships and an unfavourable appearance, most of which need rather costly and challenging multidisciplinary treatments. Thus, it should be attended by expert teams at the earliest possibility.[8] Treatment delivery should ideally be multidisciplinary, possibly involving restorative input making it a lengthy treatment process for patients with associated financial implications. Improved 4IR knowledge will allow for more centralised treatment centres to be developed, allowing for timely intervention and better communication between the patients, parents, orthodontist and the restorative specialist during the treatment process. This has the potential of improving		

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
5. Impact of oral condition (con't)		treatment outcomes and the collective experience for the patient and family.		
	2. Cranio-dentofacial anomalies: b) Cleft lip and palate (CLP) and treatment needs.	This is a global problem with approximately 10 million people affected worldwide. In Asian population, it is reported to be higher at 1:500 live births. In Malaysia, 4IR readiness is low on CLP patients and the treatments offered are not centralised such as countries in Europe, UK, Taiwan, US etc. Improve outcomes and provide an opportunity to establish national registries and emphasise the opportunities for building research platforms of relevance.[9]	1. Prevalence and characteristics of CLPs in Malaysia. 2. OHRQoL of CLP patients. 3. Outcome of care for CLPs. 4. The protocol in the management of CLP patient in Malaysia. 5. GIS mapping to visualise the burden of dentofacial anomalies in different target groups according to regions and socio-economic indicators.	1. Create a CLP registry. 2. Burden of care, treatment needed and healthcare financing. 3. Predictors of risk factors associated with the CLPs in Malaysia. 4. Centre of training & research for Cleft and Craniofacial Orthodontics. Create awareness of a few national centralised "one-stop" hospitals to cleft teams with a sufficient volume of patients to develop proficiency and measure the quality of outcomes. The latter needs to be benchmarked against the better centres in Europe.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
5. Impact of oral condition (con't)	3. Outcomes of orthodontic treatment.	The peer assessment rating (PAR)[10] is an occlusal index used on study models to determine the initial degree of malocclusion, results of treatment and amount of improvement. It is an objective method of measurement to establish if a beneficial improvement has been achieved for an individual case as well as the proportion of cases that show clinical improvement. This index has been found to be a reliable and valid tool. The PAR index[11] allows for the categorisation of cases into greatly improved, improved, worse or no different. This will enable the quality of care being provided to patients to be assessed. The PAR score is able to demonstrate if clinicians are providing treatment to patients who are in great need of treatment and that they have been treated to a high standard of care. This information is useful to understand and improve the quality of care being provided to patients as well as to ensure patient satisfaction with orthodontic treatment.	1. Measures the standards of care provided. 2. OHRQoL studies. Measures satisfaction with orthodontic care.	1. Treatment duration vs quality of treatment outcomes. 2. Understanding of the treatment provided-identifies the difficult and complex cases. 3. Improvements of orthodontic care and outcomes. 4. Allow management of patient expectations and enhance satisfaction with treatment. 5. National orthodontic referral guidelines.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
5. Impact of oral condition (con't)	4. Orofacial pain such as trigeminal neuralgia, temporo-mandibular joint disorders (TMD), burning mouth syndrome and treatment needs.	1. Large nationwide studies on the prevalence of orofacial pain, however, the impact on lifestyle/ quality of life are still lacking. 2. Utilising the new tool to diagnose TMD (Diagnostic Criteria for TMD) both in English and Malay version which has just been validated and published.	1. Epidemiological study. 2. Disease predictor via AI model. 3. Possible predictors in risk groups and impact on lifestyle. 4. Efficacy of treatment modality. 5. Comparison studies with other diagnostic tools for TMD (e.g.: FAI, OHIP-TMD etc.)	1. Burden of oro-facial pain and treatment needs. 2. Data on disease burden for health planning and financing. 3. Predictors/ associated risk factors to oral diseases identified. 4. Treatment needs. 5. Better quality of life. 6. Usefulness of TMD diagnostic tools in local settings. 7. National data on prevalence of TMD in Malaysia and can be compared within variety of other oral health condition.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
5. Impact of oral condition (con't)	5. Orofacial dental trauma including sport injuries, motor vehicle accident (MVA) and treatment needs.	1. Lack of national data on orofacial and dental trauma: • To date, no established data of facial trauma available for Malaysian; • There is no epidemiological data pertaining to orofacial trauma in children. The only data available was traumatic dental injury among 12-years-old schoolchildren in 2017. 2. The prevalence of traumatised permanent anterior teeth in NOHSS 2017 was 7.2% and it is an increasing trend from 2.5% (1997) to 5.4% (2007) to 7.4% (2017).[12] 3. Lack of national data regarding dental trauma among 0-16 years old children/ adolescent referred and treated at secondary/ tertiary level.	1. Epidemiological study in investigating dental injuries related to various aetiologies including sports in children. 2. Financial cost burden by patients, healthcare facilities following dental injuries that received early and delayed referral to specialist clinic/ GDP. 3. Epidemiological study in investigating pattern of referral, prevalence and severity of dental trauma cases referred to secondary/ tertiary care. 4. Epidemiological study on dental injuries related treatment and rehabilitation in tertiary care level.	1. Burden of orofacial & dental trauma and treatment needs in children aged 0-16 years old. 2. Development of a clinical pathway for referral to specialist clinic. 3. Development clinical management protocol. 4. Prevalence of injuries following MVA to enable change in road safety policy at national level.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
5. Impact of oral condition (con't)	5. Orofacial Dental Trauma including sport injuries, MVA and treatment needs. (con't)		5. Randomised controlled trials on treatment for dental injuries involving dental pulp and impact on OHRQoL. 6. Pattern/ type of facial and dental trauma related to MVA/ domestic violence/ sports injuries.	
	6. Molar-Incisor Hypo-mineralisation (MIH)	MIH is a hypomineralised enamel that is soft, porous and easily fracture under masticatory forces of first permanent molars (FPM) and permanent incisors.[13] Recent meta-analyses showed that MIH affects around 13%–14% of the children worldwide.[14] There is yet no national data on MIH prevalence among Malaysian children. The suitable age for detection is 8-year-old children as the FPM and permanent incisors have fully erupted. At the age of 5-year-old, both FPM and permanent incisors have not erupted yet. However, at the age of 12- & 15-year-old, it is too late for detection.	1. Epidemiological study on prevalence and severity of MIH among school children aged 8-year-old. 2. Predictors and associated risk factors of developing MIH. 3. Assess knowledge and practice among dental healthcare workers in the management of MIH.	1. Burden of MIH - prevalence and severity and its associated factors. 2. Development of a preventive management and clinical pathway in managing MIH.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
5. Impact of oral condition (con't)	6. Molar-Incisor Hypo-mineralisation (MIH) (con't)	Identification of this population and their associated risk factors are important for early detection at community level. The characteristics are: 1. Loss of enamel can occur rapidly after eruption (posteruptive breakdown) and present the risk of early extraction first permanent molar before 12 years old; 2. Defective molars are more susceptible to plaque accumulation and dental caries. Hence, it requires greater treatment needs; 3. Altered porous enamel causes bonding to enamel difficult. This can lead to frequent loss of restorations and repeated treatment that can increase the cost of treatment; 4. Difficult to anesthetise the tooth due to subclinical inflammation of the pulpal cells due to enamel porosity. Child is hypersensitivity and has higher dental fear and anxiety;	4. RCT study on the preventive management or interim therapeutic management for MIH. 5. GIS mapping to visualise the burden of MIH in different target groups according to regions, socioeconomic indicators (household income, education level, occupation, area deprivation index, etc).	

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
		5. Child requires specialist care for the dental treatment for advanced restorative and behaviour management.		
6. High mortality & morbidity associated with oral cancer and inadequate local data on oral potentially malignant disorders (OPMDs)	1. Assessment of oral cancer literacy and uptake of cancer prevention strategies.	1. Oral Cancer is one of the highly prevalent cancers worldwide and a leading cause of mortality in certain regions like South-Central Asia.[15,16,17] 2. Population awareness level of oral cancer and OPMDs is much lower than other prominent cancers in Malaysia. Considering that most patients are only being diagnosed at advanced stages in Malaysia (67% at advanced stage) this signals the urgent need to assess health literacy in our population.[18] 3. The compliance for oral screening programmes at community level is still very low denoting the urgent need to assess the public's perception of screening as this is essential for early detection.	1. Assessment on oral cancer health literacy of the general public and its relation to oral cancer prevention, screening, diagnosis and treatment. 2. Assessment of awareness and practice of oral cancer screening among the general public. 3. Exploration of best modality/ channel/ strategies/ methods in educating the general public about oral cancer, according to specific population (strategic communication). 4. Monitoring and evaluation of existing oral cancer-related health	1. Proposal of strategies to improve cancer prevention and health promotion, based on the findings. 2. Proposal of the best platform/strategy to disseminate oral cancer health related information, according to the target audience. 3. Strategies to improve oral cancer- related health promotional activities. 4. Fully understand the cost of oral cancer management to support the practice of value-based medicine.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
6. High mortality & morbidity associated with oral cancer and inadequate local data on OPMDs (con't)	1. Assessment of oral cancer literacy and uptake of cancer prevention strategies. (con't)	4. Current strategies of addressing communities of different sociodemographic, socioeconomic and risk profiles have never been evaluated, considering that it is absolutely essential for effective communication and patient compliance. 5. Very essential to determine the effectiveness of the strategies that have been in place for many years in order to achieve the 30% set target for National Oral Health Plan for early detection (stage 1 & 2) of oral cancer cases. 6. Limited data from isolated research projects on knowledge of oral cancer, risk factors and prevention has been explored in small samples reported in less than five (5) published papers. Essential as a Whole Population Approach (WPA) strategy to educate the Malaysian population for the control of oral cancer in the country.	promotional activities provided by MOH. 5. Conduct survey on public awareness of oral cancer risk factors. Conduct survey on general public knowledge on signs and symptoms of oral cancer.	

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
6. High mortality & morbidity associated with oral cancer and inadequate local data on OPMDs (con't)	2. Evaluation of the economic impact of oral cancer & OPMDs from the perspective of society.	Urgently needed for timely planning purposes and to assess true financial impact of oral cancer in Malaysia. A recent study has shown that provision of subsidies may not be adequate to shield the more vulnerable group from catastrophic healthcare expenditure when they are diagnosed with OPMD and oral cancer.[19]	1. Measure the degree of disease burden/ collect and analyse the information available for disease burden. 2. Estimate the value of productivity loss as a result of oral cancer mortality and morbidity, e.g., absence from work, premature mortality. 3. Assessment of financial toxicity among oral cancer patients undergo cancer treatment.	Clearer insight of the disease burden (productivity loss) caused by oral cancer. Proposal of strategies to improve equitable cancer care.
	3. Evaluation and provision of evidence to strengthen the existing national HPV immunisation programme.	There is a lack of local studies looking into the Human Papillomavirus (HPV) burden in oral squamous cell carcinoma.	Assessment of burden and clinicopathological features of HPV associated oral cancer.	Data will inform stakeholders on need for potential expansion of existing HPV vaccination programme and possibly gender neutral vaccination.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
6. High mortality & morbidity associated with oral cancer and inadequate local data on OPMDs (con't)	4. Provision of evidence for the development of oral cancers prevention programmes based on known general and specific risk factors.	1. There is a need for contemporary evidence for development of oral cancers prevention programmes based on known general and specific risk factors. 2. Inadequate data on the determinants of risk factors (other than smoking) and interventions. Although non-smoking risk habit are small compared to smoking, most of the oral cancers are related to these other habits.	1. Obtain contemporary data on risk factors such as: - smoking; - betel quid (areca nut); - other less studied habits; - obesity; - intake processed food; - exercise; - stress; - traditional practices; - etc. 2. Evaluate the knowledge and understanding of the risk factor determinants. 3. Intervention studies including for smokeless tobacco and areca nut quid chewing.	1. Propose strategies to develop novel approaches to prevention. 2. Form basis for more focused awareness and prevention programmes including innovative educational tools. 3. To make available set of intervention methods suitably targeted to the selected population. Intervention studies would form the basis for future policies on risk factors.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
6. High mortality & morbidity associated with oral cancer and inadequate local data on OPMDs (con't)	5. Assessment of the aetio-pathogenesis of oral cancer to assist in prevention.	1. Limited reliable model system for study of oral carcinogenesis and to test chemoprevention agents. 2. Better understanding to improve preventive strategies especially in the local setting.	1. Study the role of environmental, dietary, pathogens and host factors in oral carcinogenesis. 2. Develop & augment model systems to study carcinogenesis. 3. Studies (observational and interventional) on cessation of high-risk habits associated with development of oral cancer and OPMDs. 4. Map molecular pathways involved in oral carcinogenesis. 5. Studies on the modulation of carcinogenesis process for oral cancer prevention including genetic variants of immune epitopes.	Novel discoveries on the mechanism of carcinogenesis and new ways to modulate the process.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
6. High mortality & morbidity associated with oral cancer and inadequate local data on OPMDs (con't)	6. Exploration of the underlying phenomenon of delayed diagnosis and treatment amongst oral cancer patients in Malaysia.	1. Delay in diagnosis and treatment will give impact to prognosis and quality of life of oral cancer patients.[15,18] 2. Insufficient data on the natural history of OPMDs and its predictors of malignant transformation. 3. There is a lack of local studies on factors that causes delayed diagnosis and treatment amongst oral cancer patients. Barriers and facilitators in local setting need to be explored from time to time. 4. To explore and improve professional support on oral cancer patient's psychological aspect during the process of diagnosis and adherence to treatment.	1. Explore existing facilitators and barriers to initiate and maintain oral cancer treatment. 2. Understanding ideas and perception of the patients upon diagnosis of oral cancer and prior to starting treatment. 3. Experience exploration for patients undergoing diagnosis and treatment.	Improved understanding of barriers and facilitators during diagnosis and treatment to enable deployment of strategies to improve timeliness from symptom presentation to diagnosis to treatment initiation.
	7. Improve early detection of oral cancer & oral OPMDs.	1. A very high percentage of oral cancer cases diagnosed at stage III and IV in Malaysia. Public awareness of the importance of oral cancer screening programme is crucial.[18]	1. Epidemiological study – prevalence, incidence of OPMDs and the malignant transformation rate. 2. GIS mapping to visualize the burden of oral cancer	1. Development of molecular screening tests with high clinical accuracy. 2. Reduce disease burden.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
6. High mortality & morbidity associated with oral cancer and inadequate local data on OPMDs (con't)	7. Improve early detection of oral cancer & oral OPMDs. (con't)	2. A subset of oral cancer is believed to be preceded by OPMDs.[15] 3. Oral cancer screening is a tool to identify OPMDs and early stage oral cancer. 4. Early diagnosis and treatment are essential to long term survival.[15] Therefore, there is a need to assess public's knowledge, attitude and practice towards oral cancer screening need to improve awareness of oral cancer among general public in Malaysia. 5. Evaluation is needed to assess the effectiveness, feasibility or inequalities in the oral cancer screening programme.	& OPMDs and treatment needs in different target groups according to regions, socioeconomic indicators (household income, education level, occupation, area deprivation index, etc.). 3. Evaluation of the performance and impact of the existing oral cancer screening programme. 4. Assessment of feasibility in upscaling the existing oral cancer screening programme (barriers & facilitators of implementation and economic evaluation). 5. Mapping of resources and facilities of oral cancer screening programme with respective cancer	3. Improve quality of life. 4. Generate evidence for policymakers to improve strategies for cancer screening/ early diagnosis.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
6. High mortality & morbidity associated with oral cancer and inadequate local data on OPMDs (con't)	7. Improve early detection of oral cancer and OPMDs. (con't)		burden and its uptake of screening programme. 6. Assessment of inequity and inequalities in oral cancer screening. 7. Exploration of healthcare system and healthcare providers challenges in implementing oral cancer screening programme. 8. Development & evaluation of accurate (high sensitivity & specificity) molecular screening tests for oral cancer & OPMDs. 9. Identify predictors for oral cancer and OPMDS among high-risk groups. 10. Identify predictors for malignant transformation in OPMDs.	

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
6. High mortality & morbidity associated with oral cancer and inadequate local data on OPMDs (con't)	8. Identification & validation of predictive and prognostic clinico-pathological features & biomarkers for companion diagnostics for oral cancer and OPMDs.	1. Data on clinico-pathological features as prognostic factors and biomarkers for companion diagnostics can help improve management and clinical outcome.[15,20,21] 2. Many biomarkers have been suggested to significantly impact diagnosis and prognosis of oral cancer and OPMDs but validation is lacking.[15,20-23]	1. To identify and validate potential clinico-pathological features and biomarkers for patient risk stratification and treatment planning as well for detection of recurrence and/ or distant metastasis for oral cancer. 2. Clinical utility of sentinel lymph node biopsy for oral cancer management in the Malaysian setting.	1. Identification and verification of clinical utility of clinico-pathological features and biomarkers for companion diagnostics and/ or prognosis for oral cancer and OPMDs to improve patient management. 2. Protocol for use of biomarkers for clinical care. 3. Provide evidence for improved management of disease. 4. Evidence for policymakers to improve strategies for cancer treatment and/ or management.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
6. High mortality & morbidity associated with oral cancer and inadequate local data on OPMDs (con't)	9. Treatment and management.	1. Around 30 – 50% of patients die from the disease within 5 years and survival rates have not improved over the years.[15] 2. Insufficient proper standardised evidence-based interventions for OPMDs. 3. Better agents and methods needed for the management of OPMDs and oral cancer to improve clinical outcome and survivorship. 4. Aside from treatment modalities, strategic communication is important in improving the understanding of patients as well as obtaining good co-operation and compliance.	1. Development of shared decision-making tool in the process of deciding the option for treatment. 2. Assessment of inequity and inequality in cancer treatment. 3. Exploration of the needs, barriers, challenges, and factors associated with the accessibility of treatment. 4. Evaluation of the treatment process pathway for oral cancer patients. 5. Assessment of the variation in oral cancer treatment and its performance across different settings.	1. Strategies to improve treatment and management of oral cancer patients. 2. Identification and validation of candidate drugs/ herbal/ biologics/ immunotherapy with evidence to justify clinical trials. 3. Strategies to improve equity in oral cancer care.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
6. High mortality & morbidity associated with oral cancer and inadequate local data on OPMDs (con't)	9. Treatment and management. (con't)		6. Evaluation of current methods of surgical margin assessment. Development of better methods for assessing surgical margins. 7. To explore brachytherapy treatment for oral cancer in Malaysia. 8. To investigate the oncological effect of neoadjuvant chemo-therapy and its influence on the following surgery in patient with resectable locally advanced oral squamous cell carcinoma. 9. To identify mechanisms of resistance to therapeutic agents and immune-evasion to improve the effects of potential therapeutic agents.	

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
6. High mortality & morbidity associated with oral cancer and inadequate local data on OPMDs (con't)			10. Identify new therapeutic targets and agents for oral cancer and OPMD.	
	10. Rehabilitation and survivorship	1. As part of total/ holistic patient care, a central principle practiced in the management of oral cancer patients, quality of life (QoL) is an important adjunct assessment tool to evaluate the effectiveness of different treatment modalities from patients' perspective. 2. An important determinant of oral cancer patients' quality of life especially in a multicultural and religious society in Malaysia and has been also proven in literature to be an important component of supportive care.	1. Identification of oral cancer survivors' needs. 2. To assess the QoL of caregivers for oral cancer patient (Exploration of the challenges and view of healthcare providers in oral cancer rehabilitation services. 3. To identify barriers and facilitators to implement/ improve rehabilitation services. 4. To assess patient's quality of life after treatment of oral cancer in relation with different type of cancer treatment modalities and reconstruction.	1. Strategies to improve rehabilitation services for oral cancer survivors. 2. To develop strategies to improve patient's quality of life post-treatment (improved survivorship).

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
			5. To assess role of spiritual support of religion and support group for oral cancer care.	
7. High oral disease burden of target groups	Oral health condition of special children: - Children receiving chemotherapy for cancer treatment - Children with haemophilia.	Children who undergo chemotherapy have a risk of developing oral complications such as pain, oral ulcerations, bleeding and secondary infections such as candidiasis.[24] In addition, due to the patient's immunocompromised condition, any current or possible sources of oral or dental infections and or soft tissue trauma will jeopardise medical care, resulting in increased hospitalisation days and costs, morbidity and potential risk or mortality. All children undergoing chemotherapy should dental follow-up. Haemophilia children requiring dental treatment can face life threatening complications if not manage and treated properly. This condition can cause prolonged hospital stay and incur additional cost, risk of morbidity and potential risk of mortality. All haemophilia children should have preventive measures and regular dental follow-up at early age.[25]	1. Epidemiological study on the caries prevalence, oral health status and oral complications in children with childhood cancer and haemophilia children. 2. Assess knowledge among healthcare workers regarding oral complications related to chemotherapy, relevant management protocols of haemophilia children.	1. Burden of caries and oral complications due to chemotherapy in childhood cancer and haemophilia children. 2. Suitable protocols for management of oral complications in children undergoing chemotherapy and haemophilia children.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
8. High oral disease burden among patients with special health care needs	1. Oral health status/ oral disease burden and treatment needs of adults with special needs: ● Treatment needs (e.g., restoration, extraction, periodontal therapy, endodontics, prosthodontics, etc) including data on those who require special treatment approaches such as sedation (oral, inhalation,	1. The oral health status/oral disease burden, treatment needs and oral health related quality of life (OHRQoL) of adults with special needs in Malaysia is currently unknown. 2. Identification of oral disease burden and treatment needs of adults with special needs across the age spectrum, gender, categories of special needs, state/region and socio-economic status is important to facilitate oral health planning, which includes development of facilities and human resources, as well as formulation of policies and promotional activities targeting the population of people with special needs. 3. Investigation on the impacts of OHRQoL for adults with special needs allows identification of areas that need to be focused and/or improved, so that oral health plans, policies and activities can be developed strategically and implemented effectively.	1. Epidemiological study on oral health status/oral disease burden and treatment needs among Malaysian population of adults with special needs. 2. GIS mapping representing the burden of oral diseases in adults with special needs across the country. 3. OHRQoL study involving adults with special needs .	1. Data on the oral health status/ oral disease burden and treatment needs among Malaysian population of adults with special needs. 2. GIS mapping of oral disease among adults with special needs across the country. 3. Data on factors and predictors associated with OHRQoL among adults with special needs.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
8. High oral disease burden among patients with special health care needs (con't)	intravenous), general anaesthesia and domiciliary care. 2. Impacts of oral diseases on quality of life of the different groups of adults with special needs.			
9. High percentage of dental fear and anxiety	1. Dental fear and anxiety in children and adolescents. 2. Validation of dental anxiety scale.	Although there are many tools which can be used to measure anxiety, there is no golden standard. The use of anxiety scale is also poor among general practitioners. There needs to be more studies to validate and standardised the tools based on local settings.[26]	1. Epidemiological study on dental anxiety among children and adolescents. 2. Validation of dental anxiety scales.	1. Factors influencing anxiety levels in children undergoing dental treatment. 2. Prevalence of dental anxiety among children.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
10. No standard treatment needs index for all parties	1. Dental caries. 2. Treatment needs / demands. 3. Gerodontology	1. To link and incorporate ICDAS with treatment needs. 2. Universities have yet to develop official difficulty index while the KKM counterpart has been using the RDITN and is widely used nationwide for the purpose of filtering cases prior to referring to specialists. The aim is to adopt and further develop this index to be used as a standard difficulty index for all parties. This will definitely enhance communication among parties in all aspects (problems, risks, options, etc) concerning restorative cases. 3. Root caries.	1. Incorporation/ application of ICDAS classification in the diagnosis and usage of treatment planning. 2. Standard difficulty index (missing) (endo, caries)- currently MOH already has case difficulty index, to expand to university for standardisation. 3. RDITN (restorative dental index of treatment needs) for referral. 4. Classification of restorability. 5. Tooth wear/ tooth surface loss (TSL). 6. Pulpal pain. 7. Treatment failures and management. 8. Maintenance. 9. Clinical audit. 10. Perio – endo lesions. 11. Maxillofacial prosthodontics. 12. Relationship of systemic disease.	1. Conduct a survey run by primary cares using the ICDAS classification. 2. Develop Clinical governance (standardised data collection/protocol): a) Perform clinical audit. 3. Develop standard management / CPG. 4. Conduct survey & analyse impact on QoL /Patient reported outcome. 5. Develop Clinical governance (standardised data collection/protocol) a) Perform clinical audit 6. Develop Standard management / CPG. 7. Conduct survey & analyse impact on QoL /Patient reported outcome.

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
10. No standard treatment needs index for all parties (con't)			13. Dental trauma . 14. Sport dentistry.	8. Conduct survey and analyse the effectiveness of oral health services (start of service vs upon retirement)- health care provider/worker. 9. Analyse/ Evaluation of treatment modality/Quality of clinical services. 10. Conduct oral health studies in sport (eg epidemiology, prevalence, treatment modalities, prevention, management.
11. Mandibular full denture dilemma	Oral Health Related Quality of Life (OHRQoL).	Where implant supported mandibular denture almost solve the dilemma, not everyone is suitable for this option. Suction Effective Mandibular Complete Denture (SEMCD) – using materials and treatment technic that enhance the conventional full denture fabrication has gained popularity and proven to be effective. But it is not without its own limitations.	OHRQoL looking at implant supported overdenture vs SEMCD.	

Domain 1: Oral Health Condition				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
12. Low readiness towards 4IR in perio-endo lesion	Oral Health Related Quality of Life (OHRQoL).	Both pathology process in perio and pulp tissues can precipitate the lesion. Despite decades of literature describing them, they remain an often misunderstood disease entity.	Perio-endo lesion.	

Reference:

1. Begzati A, Berisha M, Mrasori S, Xhemajli-Latifi B, Prokshi R, Haliti F, Maxhuni V, Hysenaj-Hoxha V, Halimi V. Early childhood caries (ECC)— Etiology, clinical consequences and prevention. Emerg Trends Oral Health Sci Dent. 2015 Mar 11;31
2. Oubenyahya H, Bouhabba N. General anesthesia in the management of early childhood caries: an overview. Journal of Dental Anesthesia and Pain Medicine. 2019 Dec;19(6):313-22
3. Oliveira BH, Rajendra A, Veitz-Keenan A, Niederman R. The effect of silver diamine fluoride in preventing caries in the primary dentition: a systematic review and meta-analysis. Caries research. 2019;53(1):24-32
4. Brook PH, Shaw WC. The development of an index of orthodontic treatment priority. Eur J Orthod. 1989 ; Aug11(3):309–20
5. Polder B J, Van't Hof M A, Van der Linden F P G M et al. A meta-analysis of the prevalence of dental agenesis of permanent teeth. Community Dent Oral Epidemiol 2004; 32: 217–226
6. K. Khalaf, J. Miskelly, John, E. Voge, and T. Macfarlane. Prevalence of hypodontia and associated factors: A systematic review and meta-analysis. Journal of Orthodontics 2014; 41. 299-316
7. J. A. Hobkirk, J. R. Goodman, and S. P. Jones. “Presenting complaints and findings in a group of patients attending a hypodontia clinic,” British Dental Journal 1994; vol. 177; 9;337–339
8. J. H. Nunn, N. E. Carter, T. J. Gillgrass et al., “The interdisciplinary management of hypodontia: background and role of paediatric dentistry,” British Dental Journal 2003; vol. 194, no. 5, pp. 245–251
9. Sandy, J.R., Davies, A., Humphries, K., Ireland, A., Wren, Y Cleft lip and palate: Care configuration, national registration, and research strategies -Journal of the World Federation of Orthodontists 2020 ; Volume 9, Issue 3, Supplement October, S40-S44
10. Richmond S, Shaw WC, O’Brien KD, Buchanan IB, Jones R, Stephens CD, et al. The development of the PAR index (peer assessment rating): reliability and validity. Eur J Orthod 1992; 14:125-39
11. Richmond S, Shaw WC, Roberts CT, Andrews M. The PAR index (peer assessment rating): methods to determine outcome of orthodontic treatment in terms of improvement and standards. Eur J Orthod 1992; 14:180-7
12. Ministry of Health Malaysia. National Health and Morbidity Survey 2017: National Oral Health Survey of Schoolchildren 2017 (NHMS 2017: NOHSS 2017). Vol. II: Oral Health Status of 12-Year-Old Schoolchildren. Putrajaya: Oral Health Division, Ministry of Health Malaysia; 2017

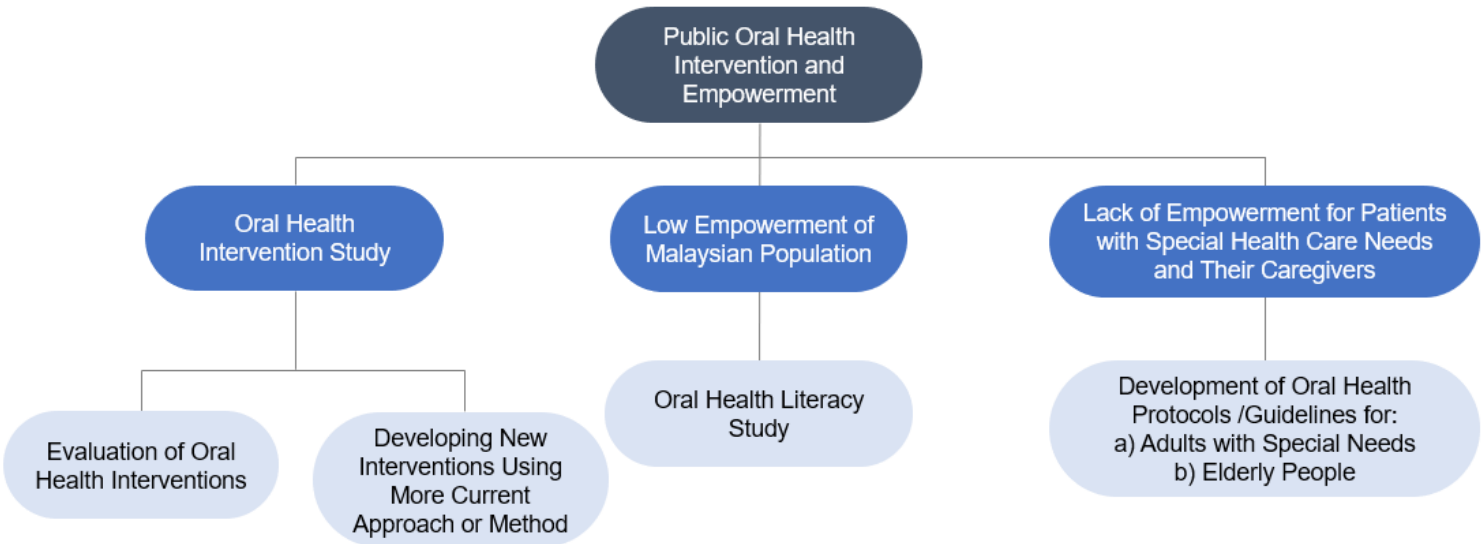
13. Weerheijm KL. Molar incisor hypomineralization (MIH). Eur J Paediatr Dent. 2003 Mar;4(3)
14. Lopes LB, Machado V, Mascarenhas P, Mendes JJ, Botelho J. The prevalence of molar-incisor hypomineralization: a systematic review and meta-analysis. Scientific reports. 2021 Nov 17;11(1):1-20
15. El-Naggar AK, Chan JKC, Grandis JR, Takata T, Slootweg PJ, editors. WHO Classification of Head and Neck Tumours. Lyon, France: International Agency for Research on Cancer; 2017
16. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2018
17. Ferlay J, Soerjomataram I, Dikshit R, Eser S, Mathers C, Rebelo M, et al. Cancer incidence and mortality worldwide: sources, methods and major patterns in GLOBOCAN 2012. Int J Cancer. 2015;136(5):E359-86
18. Malaysia National Cancer Registry Report 2012-2016. 2019
19. Raman S, Shafie AA, Abraham MT, Shim CK, Maling TH, Rajendran S, et al. Household Catastrophic Health Expenditure from Oral Potentially Malignant Disorders and Oral Cancer in Public Healthcare of Malaysia. Asian Pacific Journal of Cancer Prevention. 2022;23(5):1611-8
20. Santosh A, Jones T, Harvey J. A review on oral cancer biomarkers: Understanding the past and learning from the present. Journal of Cancer Research and Therapeutics. 2016;12(2):486-92
21. Mello FW, Melo G, Guerra ENS, Warnakulasuriya S, Garnis C, Rivero ERC. Oral potentially malignant disorders: A scoping review of prognostic biomarkers. Critical Reviews in Oncology/Hematology. 2020;153:102986
22. Sathasivam HP, Kist R, Sloan P, Thomson P, Nugent M, Alexander J, et al. Predicting the clinical outcome of oral potentially malignant disorders using transcriptomic-based molecular pathology. Brit J Cancer. 2021;125(3):413-21
23. Sathasivam HP, Nayar D, Sloan P, Thomson PJ, Odell EW, Robinson M. Dysplasia and DNA ploidy to prognosticate clinical outcome in oral potentially malignant disorders. Journal of Oral Pathology & Medicine. 2021;50(2):200-9
24. Valéra MC, Noirrit-Esclassan E, Pasquet M, Vaysse F. Oral complications and dental care in children with acute lymphoblastic leukaemia. Journal of Oral Pathology & Medicine. 2015 Aug;44(7):483-9
25. Nayak S, Govind S, Jena A, Samal P, Sahoo NK, Rath S. Evaluation of Oral Hygiene Status, Salivary Fluoride Concentration and Microbial Level in Thalassemic and Hemophilic Patients. Siriraj Medical Journal. 2022 May 1;74(5):314-22
26. Alamri SA, Alshammari SA, Baseer MA, Assery MK, Ingle NA. Validation of Arabic version of the Modified Dental Anxiety Scale (MDAS) and Kleinknecht's Dental Fear Survey Scale (DFS) and combined self-modified version of this two scales

as Dental Fear Anxiety Scale (DFAS) among 12 to 15 year Saudi school students in Riyadh city. Journal of International Society of Preventive & Community Dentistry. 2019 Nov;9(6):553

DOMAIN 2

PUBLIC ORAL HEALTH INTERVENTION & EMPOWERMENT

Framework for Domain 2: Public Oral Health Intervention & Empowerment



Domain 2: Public Oral Health Intervention & Empowerment				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
1. Oral health intervention study	1. Evaluation of oral health interventions. a) Process and impact evaluation of oral health interventions; b) Impacts of population vs individual or high-risk approach oral health interventions. 2. Developing new interventions using more current approach or method.	1. Lack data on the short and long-term impacts of oral health interventions. 2. Inadequate evaluation of effectiveness of policies implemented based on the policy objectives. 3. Lack evidence on the impacts of population vs individual or high-risk approach that will allow prioritising the resources for more effective interventions. 4. New interventions more relevant to current generation and current approach is needed (e.g., oral health application, social media etc.).	1. Process and impact evaluation of oral health interventions. 2. Evaluation on policy acceptance, uptake and implementation. 3. Impacts of population versus individual or high-risk oral health interventions. 4. Intervention studies on newly develop oral health interventions. For example: • Programmes to stop initiation of smoking habits amongst school children; • Use of silver diamine fluoride (SDF) as a dental caries preventive agent; • Acceptance of SDF among public/ dental personnel;	1. Identification of effective interventions. 2. Strategies to ensure effective implementation of policies and inputs to review or to formulate new policies.

Domain 2: Public Oral Health Intervention & Empowerment				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
1. Oral health intervention study (con't)			• Oral health module for athletes - training of trainer effectiveness; • Community intervention on the effects of oral health module to increase smoking cessation rate. 5. Distribution of reticulated fluoride in public water supply in relation to dental caries.	
2. Low empowerment of Malaysian population	Oral Health Literacy (OHL) study	1. Despite widespread information available to the public, fake dentistry is still a problem. Study can be carried out to evaluate populations capacity to obtain process and understand basic health information and services needed to make appropriate oral health decisions.	1. Establishment of OHL index. 2. Evaluations of population awareness towards dental services versus fake dentistry (OHL).	1. Development of OHL measurement tools. 2. Measuring OHL level among Malaysian population. 3. Evaluate oral health promotional activities based on OHL level.

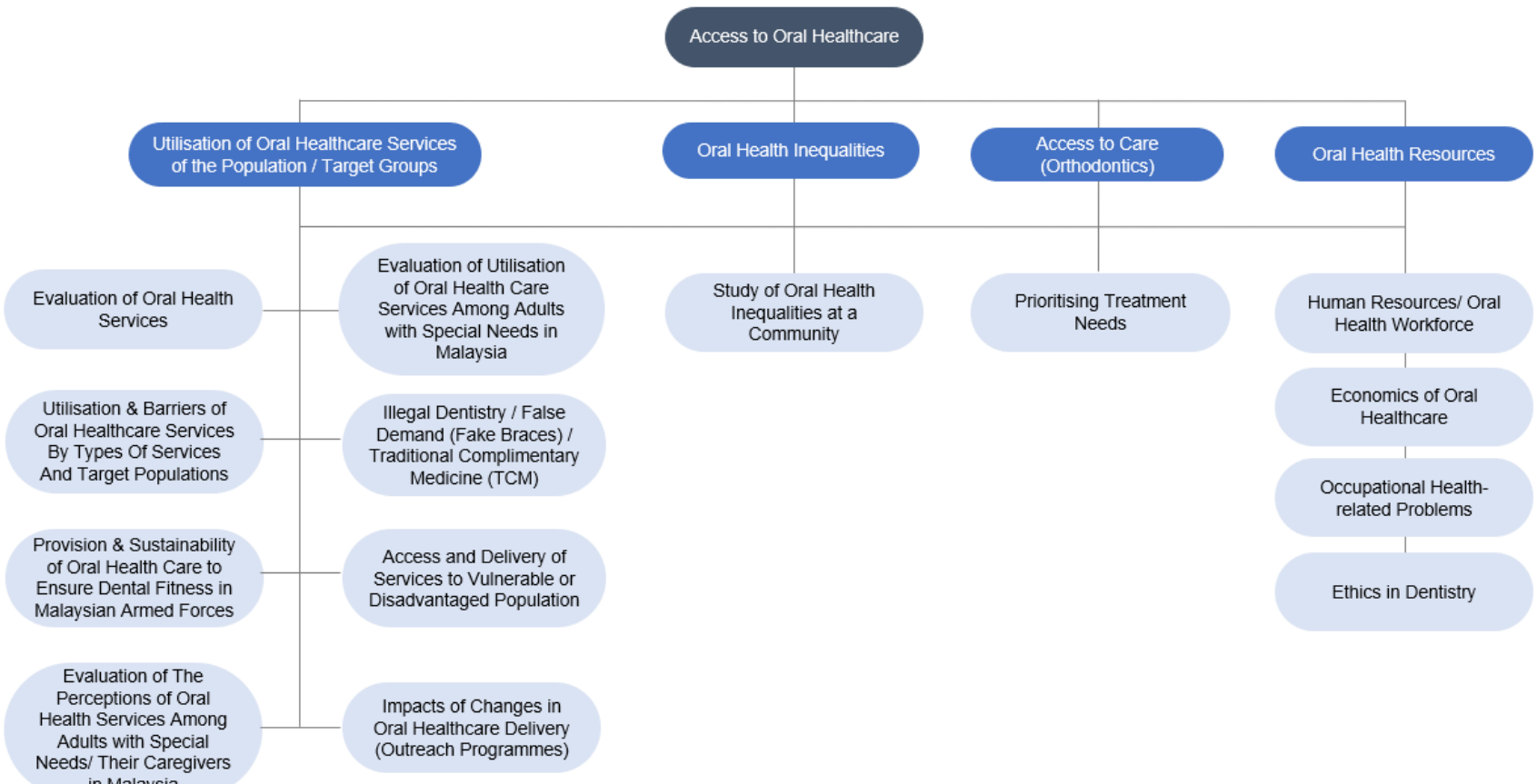
Domain 2: Public Oral Health Intervention & Empowerment				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
2. Low empowerment of Malaysian population (con't)		2. To date, there is no proper measurement tool to periodically evaluate and monitor OHL level of Malaysian population & health care workers. 3. This measurement tool will enable the government to carry effective health promotion programmes based on actual needs of the population, as well as to evaluate the effectiveness of these oral health programmes in improving OHL. 4. A specific OHL study is required to evaluate OHL of the population. 5. Lack of published studies pertaining to oral health literacy awareness among healthcare personnel in the country.		

Domain 2: Public Oral Health Intervention & Empowerment				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
3. Lack of empowerment for patients with special health care needs and their caregivers on self-care/ personal oral health care	Development of oral health protocols/ guidelines for: a) Adults with special needs; b) Elderly people.	1. Currently, there is no existing national guidelines or evidence-based protocol on the recommended daily oral hygiene regimen and general oral healthcare. 2. Development of an evidence-based oral health protocol/ guideline serves as a useful reference for adults with special needs, elderly people and their caregivers to maintain satisfactory oral health.	Meta-analysis/ systematic review of current guidelines, protocols and best practice recommendations.	1. An evidence-based oral healthcare protocol/ guideline that can be used as reference by adults with special needs/ their caregivers. 2. An evidence-based oral healthcare protocol/ guideline that can be used as reference by elderly people/ their caregivers.

DOMAIN 3

ACCESS TO ORAL HEALTHCARE

Framework for Domain 3: Access to Oral Healthcare



Domain 3: Access to Oral Healthcare				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
1. Utilisation of oral healthcare services of the population/ target groups	1. Evaluation of oral health services - focus on accessibility, affordability and utilisation of services by Malaysian Population across dental facilities in Malaysia. 2. Utilisation & barriers of oral healthcare services by types of services (primary care & specialist care services) and target populations. 3. Provision & sustainability of oral health care to ensure dental fitness in Malaysian Armed Forces (MAF) - dental readiness and military deployment.	1. To date, there is no study focusing on the accessibility and affordability of population to utilise oral healthcare services. 2. Most local study focused on the utilisation and its barriers. 3. Due to accessibility to the oral services, the percentage of health readiness and dental readiness is not at par in term of deployment.	1. Utilisation and barriers to services by types of services and target groups. 2. Impact of oral health on readiness among MAF personnel every five years. 3. Effect on access, quality of care and patient care journey following changes in mode of oral healthcare delivery. 4. Overcoming barriers on collaborations with other healthcare practitioners/ effectiveness of multidisciplinary care pathways/ effectiveness of bilateral referral practices. 5. Strategies to improve uptake of dental services. (e.g., antenatal mothers)	1. Minimum of 80% dental readiness among MAF. 2. Evidence to support formulation of strategies to redesign model of healthcare delivery.

Domain 3: Access to Oral Healthcare				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
1. Utilisation of oral healthcare services of the population/ target groups (con't)			6. GIS based research looking at accessibility domain of care versus population density. 7. Impact of willingness to pay on patient compliance (patient affordability).	
	4. Evaluation of the perceptions of oral health services among adults with special needs/ their caregivers in Malaysia of dental services in terms of physical accessibility, acceptability, affordability, availability and appropriateness. 5. Evaluation of utilisation of oral healthcare services among adults with special needs in Malaysia.	1. There is no national study focusing on patients/ caregivers' perceptions on dental services, barriers, needs, demands and its utilisation. 2. The finding is very important for financial planning towards development of: a) Infrastructure, facilities and services to accommodate the needs of patients/ caregivers; b) Human resources (training of specialists in Special Care Dentistry, general dentists as front	1. Qualitative and quantitative survey of adults with special needs/ caregivers of different categories of special needs to explore their perceptions of the current and ideal oral healthcare services in terms of: • accessibility; • acceptability; • affordability ; • availability; • appropriateness.	Identification of areas deemed important to improve access and utilisation of oral healthcare services among adults with special needs.

Domain 3: Access to Oral Healthcare				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
1. Utilisation of oral healthcare services of the population/ target groups (con't)		liners, support staff/ dental allied health practitioners, etc); c) Oral health policy and programmes for education and promotional activities, as well as preventative, definitive and long-term care (including funding of treatment fees).	2. Qualitative and quantitative survey of adults with special needs/ caregivers of different categories of special needs to investigate the use of oral healthcare services, including its associated barriers and enabling factors.	
	6. Illegal dentistry/ false demand (fake braces)/ Traditional & Complimentary Medicine (TCM)	1. Lack of data on unregulated / non-evidence based TCM in oral healthcare. 2. Factors that promoting demand to fake braces and level of awareness of the side effect of fake braces.	Prevalence of fake practice/ demand & factors influencing awareness of the side effect among the users.	Factors that promote demand to illegal dentistry/ TCM and level of awareness of the side effect of illegal dentistry/ TCM.

Domain 3: Access to Oral Healthcare				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
1. Utilisation of oral healthcare services of the population/ target groups (con't)	7. Access and delivery of services to vulnerable or disadvantaged population e.g., *orang asli*, marginalised population, etc.	The need for current data on utilisation and barriers to services according to types of services and target populations.	1. Utilisation and barriers to services by types of services and target groups. 2. Strategies to improve uptake of oral healthcare services. 3. GIS based research looking at accessibility domain of care versus population density.	Evidence to support formulation of strategies to redesign model of healthcare delivery.
	8. Impacts of changes in oral healthcare delivery (outreach programmes) on access to care, quality of care and patient care journey and satisfaction.	Data on impact of change in mode of oral healthcare delivery (e.g., introduction of *Kampung Angkat, Pemasyarakatan Klinik Pergigian Sekolah,* public private partnership in delivery of oral healthcare).	Effect on access, quality of care and patient care journey following changes in mode of oral healthcare delivery.	Evidence to support formulation of strategies to redesign model of healthcare delivery.

Domain 3: Access to Oral Healthcare				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
2. Oral health inequalities	Study of oral health inequalities at a community: 1. Inequalities in oral health among: • General population (all target groups); • Vulnerable or disadvantaged population (Special needs, cleft, HIV, elderly, prisoners, etc.). 2. Inequalities in the impact of oral diseases on the quality of life of general, vulnerable and disadvantaged populations. 3. Inequalities in the effect of oral health interventions (programmes/ policies).	1. Oral health follows a social gradient. To date, lack of evidence on oral health inequalities (whether oral health differs by any socio demographic or economic indicators) among general population, vulnerable and disadvantaged populations in Malaysia. 2. Health interventions may reduce or widen oral health inequalities. Data on the effects of oral health interventions by different social indicators would allow interventions to be tailored to the need of population. - Lack data or analysis on impact of socio-economic conditions related to median household income grouping such as B40, M40 and T20 on caries risk.	1. Inequalities in oral diseases burden among all target populations and among vulnerable/ disadvantaged populations by sociodemographic and economic indicators (household incomes, education level, occupation, area deprivation index, etc.). 2. Inequalities in the impacts of oral diseases on quality of life of both populations. 3. Inequalities in the effects of oral health interventions (water fluoridation, incremental dental care, oral health promotion activities, etc). 4. Social pathways for caries risk including social cohesion, family	Evidence or data on distribution of oral health by relevant indicators to support targeted oral health programmes and to prioritise resources.

Domain 3: Access to Oral Healthcare				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
2. Oral Health Inequalities (con't)		3. Understanding the role of social capital on caries risk and caries prevention may help reduce inequalities in oral health.	functioning and social capital. 5. Distribution/ association of area deprivation index to caries risk. 6. Strategies to coordinate oral healthcare for children and adolescents who have dropped out from the school system.	
3. Access to care (Orthodontics)	Prioritising treatment needs.	Index of Orthodontic Treatment Need (IOTN). Orthodontic needs assessment is the systematic approach to ensuring that the service uses its resources to improve the malocclusion /problem of the population in the most efficient way. The Index of Orthognathic Functional Treatment Need (IOFTN)[1] has been developed to help in the prioritisation of severe malocclusions.	1. Assessment of orthodontic treatment needs for the population. 2. The use of the IOTN in dental primary care. 3. Explore attitudes to the potential introduction of the index as a mandatory part of orthodontic provision.	1. An objective and valid method of tailoring orthodontic services to target those in need of treatment. 2. Improved resource allocation based on treatment needs.

Domain 3: Access to Oral Healthcare				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
3. Access to care (Orthodontics) (con't)		The IOFTN index is a reliable tool that should be applied to patients who, due to dentofacial deformity, are not amenable to orthodontic treatment alone. Data on the prevalence of patients requiring a combined approach of orthodontics and surgery will allow for adequate resource planning as well as the establishment of centres of excellence.		3. Reduction of orthodontic treatment waiting time.
4. Oral health resources: **A. Human resources/ oral health workforce** **B. Economics of oral healthcare** **C. Occupational health-related problems** **D. Ethics in dentistry**	**A. Human resources/ oral health workforce** 1. Capacity of oral health human resources – inequalities in human resources. 2. Mapping the distribution of human resources matches the burden of oral diseases.	1. Lack of oral health human resources studies in Malaysia. 2. To use mapping of the resources distribution with the oral health needs to overcome inequalities in oral health. Need evidence or data to support reallocation of resource to the population most in need.	1. Descriptive or trend studies on the human resources by different categories, regions, etc. 2. Geographic Information System (GIS) mapping of distribution of oral diseases and resources. 3. Life balance, satisfaction, mental health and risk factors, career pathway.	1. Effective planning of oral health resources over time to overcome inequalities in oral health. 2. Equal and fair distribution of resources based on the evidence of need.

Domain 3: Access to Oral Healthcare				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
4. Oral health resources: **A. Human resources/ oral health workforce** **B. Economics of oral healthcare** **C. Occupational health-related problems** **D. Ethics in dentistry (con't)**	3. Career pathway & life balance among dental personnel. 4. Projection of oral health human resources/ workforce planning. **B. Economics of oral healthcare** 1. Economic impacts of oral diseases burdens. 2. Cost benefit and effectiveness of oral health interventions. 3. Effective distribution of oral health funding. 4. Universal coverage for prevention. **C. Occupational health-related problems** 1. Occupational health and well-being & associated	3. Data on economic impacts of each oral diseases and oral health programmes is scarce. 4. Lack data on depression stress and anxiety/ mental health among dental personnel. 5. Limited studies on occupational abuse or harassment, safety and health (OSH) among dental personnel and students in Malaysia. 6. Due to the extensive social media use among dental professionals, the easy access and sharing of information, however, can lead to professional and ethical.	4. Projection or workforce planning studies based on the need. 5. Economic evaluation on impacts of oral diseases. 6. Cost benefit and cost effectiveness of oral health interventions (policies and programmes) such as water fluoridation, clinical preventive programme, etc. 7. GIS mapping the distribution of health funding to the need. 8. Prevalence of occupational related problems including abuse, harassment, level of protection afforded to personnel, factors associated and its association with physical	3. Baseline data for surveillance of occupational health and recommendations for healthy and safe working environment. 4. National guideline on social media use among health professionals. 5. E-professionalism syllabus for undergraduate training.

Domain 3: Access to Oral Healthcare				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
4. Oral health resources: **A. Human resources/ oral health workforce** **B. Economics of oral healthcare** **C. Occupational health-related problems** **D. Ethics in dentistry (con't)**	factors of dental personnel and dental students. **D. Ethics in dentistry** 1. Professional misconduct. 2. E-professionalism among dentists.		and psychological well-being. 9. Knowledge, Attitude and Practice (KAP) related to the issues through intervention. 10. Descriptive study on distribution of professional misconduct over time based on secondary data.	

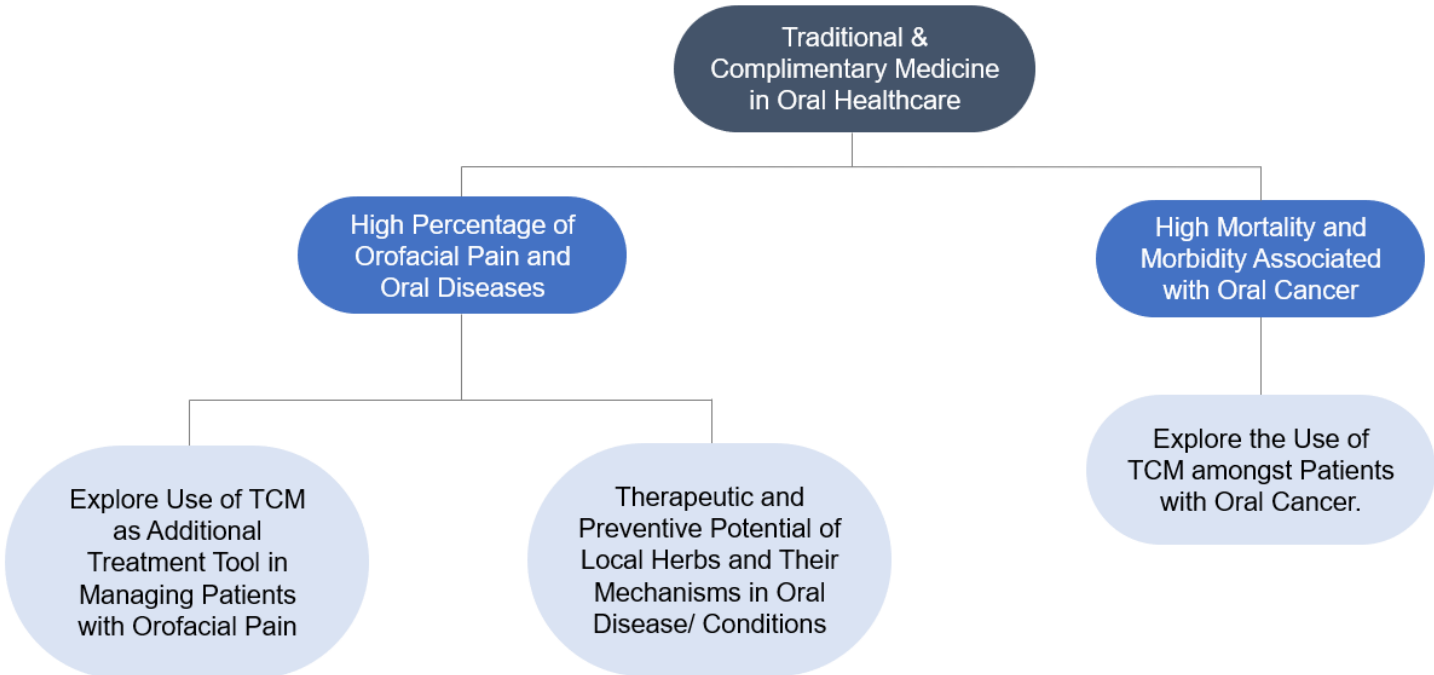
Reference:

1. Anthony J Ireland, Susan J Cunningham, Aviva Petrie, Martyn T Cobourne, Priti Acharya, Jonathan R Sandy & Nigel P Hunt An Index of Orthognathic Functional Treatment Need (IOFTN), Journal of Orthodontics 2014; 41:2, 77-83

DOMAIN 4

TRADITIONAL & COMPLEMENTARY MEDICINE IN ORAL HEALTHCARE

Framework for Domain 4: Traditional & Complementary Medicine (TCM) in Oral Healthcare



Domain 4: Traditional & Complementary Medicine (TCM) in Oral Healthcare				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
1. High percentage of orofacial pain and oral diseases	1. Explore use of TCM as additional treatment tool in managing patients with orofacial pain such as trigeminal neuralgia and temporo-mandibular joint disorders (TMD).	Scarce available data of documented studies on the use of TCM as adjunctive tool in managing these cases.	Clinical trials.	1. Burden of oral mucosal diseases for oral healthcare. 2. Predictors/ associated risk factors to the oral diseases identified. 3. Improve oral healthcare provision.
	2. Therapeutic and preventive potential of local herbs and their mechanisms in oral diseases/ conditions.	1. Role of TCM in the field of periodontal therapy, complementing the vast resources of plant products available in Malaysia need to be further explored. 2. Multi-racial, faith and belief among citizens in Malaysia diversify the types of natural products that has been used to maintain oral health. Potential and efficacy of the natural products need to be further investigated.	Exploring new therapeutic and preventive interventions to improve periodontal health using plant-based/ natural products: • In-vitro studies; • Animal studies; • Randomised Clinical Trials (RCT).	1. New business opportunities and value creation by: • Provision of evidence to facilitate production of locally made preventive/ therapeutic products in oral healthcare; • Production of locally made preventive/ therapeutic products in oral healthcare. 2. Utilise emerging technologies to improve higher value-added healthcare products available in the market.

Domain 4: Traditional & Complementary Medicine (TCM) in Oral Healthcare				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
1. High percentage of oro-facial pain and oral diseases (con't)	2. Therapeutic and preventive potential of local herbs and their mechanisms in oral disease/ conditions. (con't)	3. Need to explore new therapeutic interventions for the management of pulp therapy and oral diseases/ conditions in children.	Exploring the potential of therapeutic effect using herbal or natural product via in-vitro, in-vivo and clinical trial in the management of pulp therapy and oral disease/ conditions in children.	Useful alternative therapeutic regimes for the management of oral conditions.
2. High mortality & morbidity associated with oral cancer	Explore the use of TCM amongst patients with oral cancer.	The use of TCM has been noted among patients with cancer throughout every era. Clinicians should be knowledgeable about alternative medicine in order to counsel patients more effectively. There is a lack of data on prevalence of alternative therapy use among patients with oral cancer. To explore the patient's reasons for treatment choice.	Studies on prevalence of oral cancer patients seeking alternative therapy and understanding therapy choice preferences.	Better understanding on the use and effects of TCM in clinical outcome for patients with oral cancer.

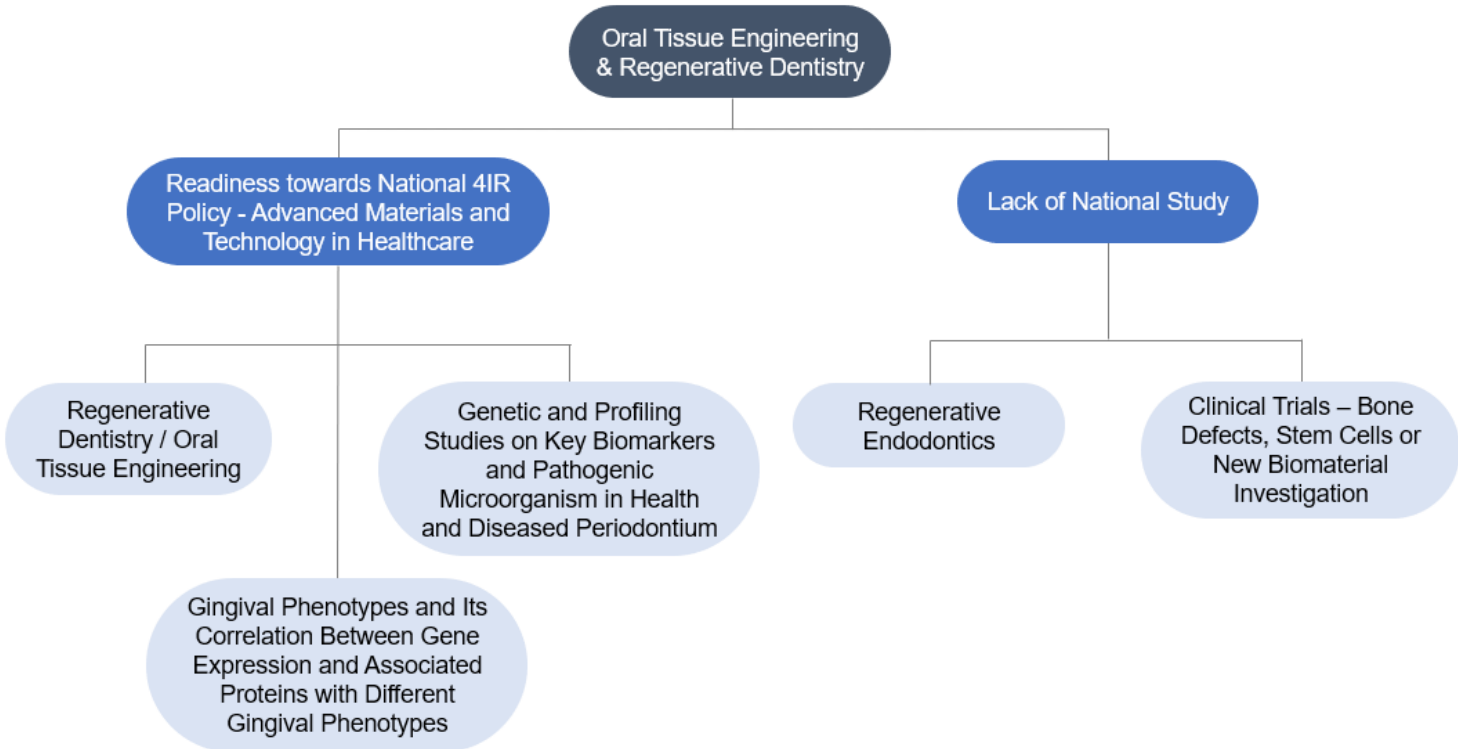
References:

1. Subramanyam D, Somasundaram S. Clinical and Radiographic Outcome of Herbal Medicine Versus Standard Pulpotomy Medicaments in Primary Molars: A Systematic Review. Journal of Clinical & Diagnostic Research. 2017 Oct 1;11(10)

DOMAIN 5

ORAL TISSUE ENGINEERING (OTE) & REGENERATIVE DENTISTRY

Framework for Domain 5: Oral Tissue Engineering (OTE) & Regenerative Dentistry



Domain 5: Oral Tissue Engineering (OTE) & Regenerative Dentistry				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
1. Readiness towards national 4IR policy - Advanced materials and technology in healthcare	1. Regenerative Dentistry/ OTE: a) Isolation and characterisation of periodontal ligament stem cells (PDLSC); b) Dental mesenchymal stem cells as cell-therapy to restore periodontal defects; c) Dental mesenchymal stem cells secretome in periodontal regeneration[1]; d) Platelet Rich Factor (PRF)/ Concentrated Growth Factor (CGF) in periodontal tissue regeneration; e) Usage of locally available alloplastic materials in bone tissue regeneration (xenografts, gypsum-chitosan, coral hydroxyapatite and others); f) Host-modulation therapies as an adjunct to conventional periodontal therapy.	1. Periodontal stem cells biobank is currently unavailable for further tissue engineering studies. 2. Data on the usage of stem cells therapy in periodontal regeneration among Malaysian populations is currently not available. 3. The biomaterials available in the market for periodontal regeneration is mostly non-halal, imported and expensive. 4. Potential of locally available alloplastic materials in bone tissue regeneration in Malaysia need to be explored. 5. Potential of host-modulation therapies as an adjunct to conventional periodontal therapy to ameliorate destructive aspects of the host inflammatory response.	• In-vitro studies • Animal studies • Randomised Clinical Trials (RCT)	1. New business opportunities and value creation by: i) Facilitation of the development of relevant biobanks in Malaysia; ii) Facilitation of the production of locally made biomolecule-based regenerative materials products; iii) Improved technology for oral tissue engineering. 2. Utilise emerging technologies to improve healthcare services delivery.

Domain 5: Oral Tissue Engineering (OTE) & Regenerative Dentistry				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
1. Readiness towards national 4IR policy- Advanced materials and technology in healthcare (con't)	2. Genetic and profiling studies on key biomarkers and pathogenic microorganism in health and diseased periodontium. 3. Gingival phenotypes and its correlation between gene expression and associated proteins with different gingival phenotypes.	1. Absence of genetic and disease biomarkers profiling database of Malaysian population. 2. Potential use of microbial genotyping in the risk assessment of periodontal attachment loss in periodontitis patients. 3. Potential use of identifying associations between genetic variants and common disease such as periodontitis and translating it to clinical care.	1. Genotype and profiling studies on: a) Biomarkers; b) Microbes; c) Others. 2. Genome-Wide Association studies (GWAs).	1. Facilitation of the development of genetic and profiling database of Malaysian population. 2. Utilise emerging technologies to improve healthcare services delivery in personalised medicine and genomics.
2. Lack of national study	1. Regenerative endodontics.	1. New treatment modalities have emerged lately in management to regenerate dentin-pulp complex. The latest concept is tissue engineering, which can be alternative option to the apexification treatment. 2. Future studies are required to analyse the risk and benefit for	1. Laboratory investigation and animal studies. 2. Clinical trials.	1. Evaluate cost effectiveness. 2. Conduct survey and analyse patient reported outcome (patient review and monitoring). 3. Develop clinical governance.

Domain 5: Oral Tissue Engineering (OTE) & Regenerative Dentistry				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
2. Lack of national study (con't)		this treatment and also the acceptance from the patients.		(standardised data collection/ protocol). 4. Clinical audit. 5. Develop standard management/ CPG.
	2. Clinical trials – bone defects, stem cells or new biomaterial investigation.	1. Healing and regeneration is a major issue in dentistry such as bone defects and inflamed or necrotic pulp. There is still a need for improvement to further understand the cellular interaction of dental stem cells, biomaterials and growth factors. 2. Stem cells therapy in dentistry and tissue grafting technology can provide a better quality of life to the patients by reducing the comorbidity in cleft children and better treatment options for pulp and periodontal treatment.	1. Coordinated clinical trials for suitable case selection of bone defects, inflamed or necrotic pulp and periodontal defects. 2. Biocompatible, cytotoxicity & success rate of stem cells therapy and newly developed biomaterial can be further investigated.	1. Improved technology for OTE. 2. Development of an in-vitro 3D model for various in-vitro tests such as biocompatibility test, drug transportation or disease process. 3. New method for treating bone defects, inflamed or necrotic pulp and periodontal defect.

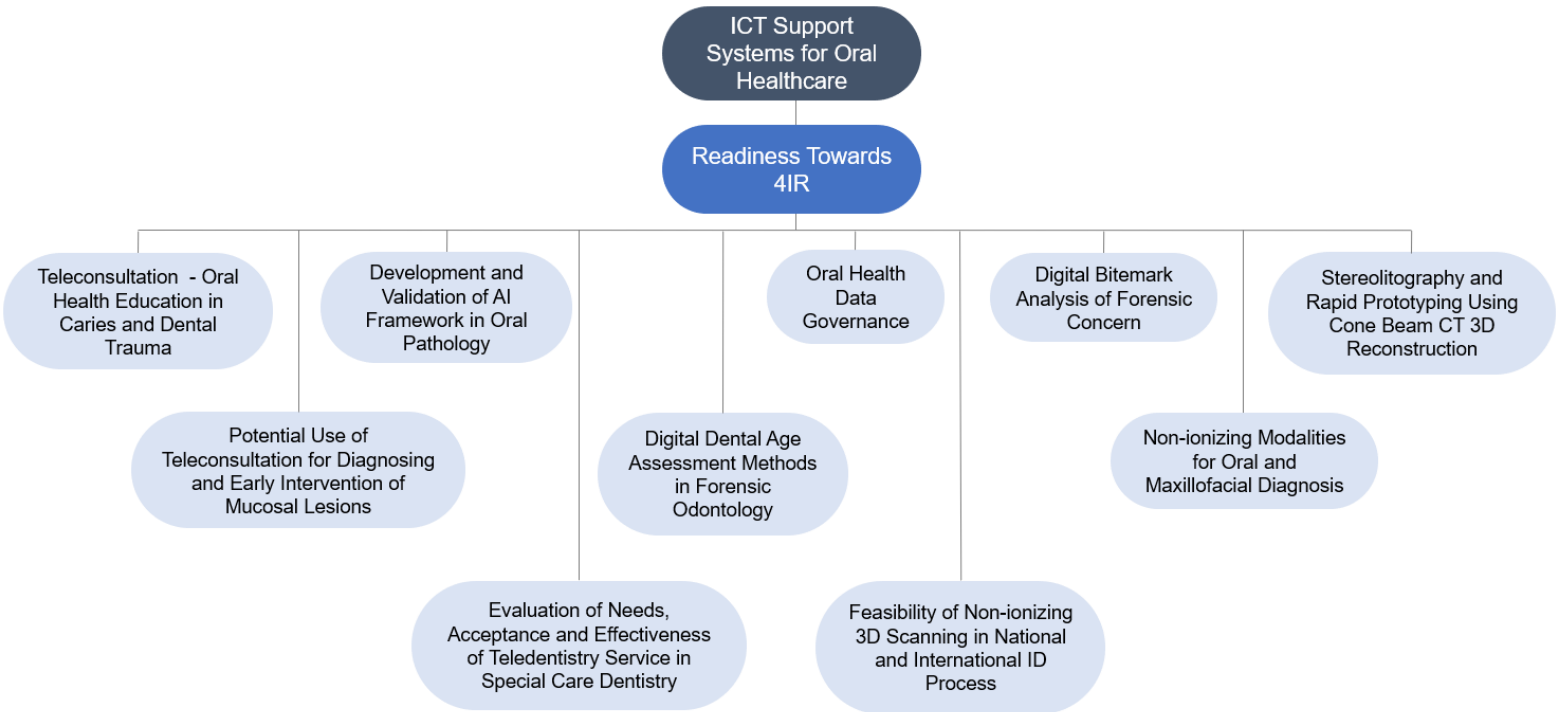
References:

1. Hagar MN, Yazid F, Luchman NA, Ariffin SH, Wahab RM. Comparative evaluation of osteogenic differentiation potential of stem cells derived from dental pulp and exfoliated deciduous teeth cultured over granular hydroxyapatite based scaffold. BMC Oral Health. 2021 Dec;21(1):1-3

DOMAIN 6

INFORMATION & COMMUNICATION TECHNOLOGY (ICT) SUPPORT SYSTEMS FOR ORAL HEALTHCARE

Framework for Domain 6: Information and Communication Technology (ICT) Support Systems for Oral Healthcare



Domain 6: Information and Communication Technology (ICT) Support Systems for Oral Healthcare				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
Readiness towards 4IR	1. Teleconsultation • Oral health education (OHE) in caries and dental trauma.	1. WHO Global Strategy for Oral Health 2021. Inclusion and community engagement: • Involvement of diverse voices of individual with the disease together with dental professionals in oral health education for empowerment of the community in oral disease prevention. • During COVID-19 pandemic, teledentistry can offer innovative solution to resume dental practice during this pandemic. Teledentistry is the remote facilitating of dental treatment, guidance and education using variety of technologies.[1]	1. The potential of tele-dentistry in supplementing continuity of care. 2. Evaluation of OHE and oral health promotion materials used in community for caries prevention.	1. Better continuity of care can be provide to the public. 2. Healthcare personnel training development for teledentistry in children oral health management. 3. Development hybrid materials for oral health education in children.
	2. Potential use of teleconsultation for diagnosing and early intervention of mucosal lesions.	COVID-19 pandemic has opened up avenues for the possibility of teleconsultation. • This will improve the detection of mucosal lesions and proper management especially for rural	1. Validation and comparative studies on the accuracy of teleconsultation for mucosal lesions.	1. Increase detection rate. 2. Improve provision of services. 3. Make available pool of national data for auditing

Domain 6: Information and Communication Technology (ICT) Support Systems for Oral Healthcare				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
Readiness towards 4IR (con't)		clinics where specialist healthcare is not readily available. • No data on usefulness of using ICT in ensuring national standards and credibility of oral medicine criteria and standards in diagnosis and management.	2. Evaluate the effectiveness of detection of mucosal lesions through teleconsultation. 3. Impact on patient acceptance and potential compliance to treatment provision.	on success and failures of diagnosis and management.
	3. Development and validation of artificial intelligence (AI) framework.	AI is at the cutting edge of modern technology and emerging uses within the healthcare sector are now being realised especially in pathology and oral lesion detection & recognition. [2,3,4,5] The potential of AI is to create image analysis tools which could either be used for diagnostic support or to derive novel insights into disease biology, in addition to those achievable with a human observer. Some examples providing diagnostic support currently exist for a limited,	1. To study its potential workflow applications and give key examples of the potential for AI in clinical practice. 2. Evaluate usefulness as prognostic and predictive tool. 3. Comparative studies on telediagnostics	1. Considerations and justifications for the implementation of AI in practice to be studied. 2. Potential to reduce human error and improve accuracy of diagnoses. 3. Create ICT-based national standards and criteria towards overall credibility

Domain 6: Information and Communication Technology (ICT) Support Systems for Oral Healthcare				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
Readiness towards 4IR (con't)		but expanding number of applications, such as oral lesion and tumour detection, automated tumour grading, immuno-histochemistry scoring and predicting mutation status. Lack of available data on usefulness and credibility of advanced ICT services in ensuring comparable standards as conventional diagnostic oral pathology and oral lesion.	(telereporting vs manual reporting).	of oral pathology diagnostics and other diagnostics. 4. Make available pool of national data for auditing on success and failures of diagnosis.
	4. Evaluation of needs, acceptance and effectiveness of teledentistry service in Special Care Dentistry among adults with special needs/ their caregivers and dental professionals.	Teledentistry service has been developed to facilitate adult patients with special needs/ their caregivers obtain information, especially at times when they are not able to physically access professional oral healthcare (e.g., during COVID-19 movement control order). However, users' perceptions of the needs, acceptance and effectiveness of the teledentistry service is unexplored.	1. Quantitative and qualitative survey on the use of teledentistry service in Malaysia (in terms of its needs, acceptance and effectiveness), involving: • adults with special needs/ their caregivers; • dentists and specialists.	1. Identification of the needs and acceptance of the teledentistry service among adults with special needs/ their caregivers, dentists and specialists. 2. Identification of perceptions among adults with special needs/ their caregivers, dentists and specialists on the effectiveness of the teledentistry service at the current stage and

Domain 6: Information and Communication Technology (ICT) Support Systems for Oral Healthcare				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
Readiness towards 4IR (con't)				recommendations for future improvements.
	5. Oral health data governance • Big data - Availability, integration, data analytic, appropriateness of data • Oral healthcare - Integrated dental and medical report	Digital dentistry is the way forward. This technology has many advantages, including accurate measurements, big storage, time-saving, enable online consultation and presentation, real time information exchange with different centres for planning and appraising medical procedures and treatments, etc. Therefore, more research should be geared towards enhancing the use of digital dentistry.	1. Usability & acceptance study using digital dentistry among health care workers including: • Internet capabilities; • Integration with medical. 2. The impact of digital health passport (ownership of own health data – seamless data) in improving oral health outcome/ health compliance. 3. The usage of dental records among MAF and MOH.	1. Utilisation of massive data to plan and project health over time. 2. Easier access and continuation of dental treatment without bringing manual dental cards. 3. National registry for craniofacial deformities.

Domain 6: Information and Communication Technology (ICT) Support Systems for Oral Healthcare				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
Readiness towards 4IR (con't)			4. Registration of craniofacial deformities. 5. Ethics and legal considerations related to privacy and confidentiality, patient safety, etc.	
	6. Digital dental age assessment methods in forensic odontology.	1. Increase the accuracy and speed for forensic age assessment as part of the disaster preparation and mitigation.[6,7] 2. Dependency on conventional way of dental age estimation may lead to expert biasness and slow down the forensic process especially during disaster victim identification. 3. Faster digital system will reduce the responders' deployment to the site which may incur costs to transportations and logistics.	AI and machine learning of dental age estimation methods.	Novel digital system or application-based software (applications).

Domain 6: Information and Communication Technology (ICT) Support Systems for Oral Healthcare				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
Readiness towards 4IR (con't)	7. Digital bitemark analysis of forensic concern.	1. Conventional approach of bitemark analysis is prone to error and risks of inadmissibility in the court of law. 2. Inadmissibility of bitemark evidence in the court of law will destroy the fraternity's integrity and lead to loss of public trust.[8] 3. The guilty may escape punishments which may expose the society to the imminent danger and insecurity.	Digital bitemarks analysis using finite element analysis.	Accurate and irrefutable evidence for bitemark analysis.
	8. Feasibility of non-ionising 3D scanning in national and international ID process	1. Potential technology to substitute conventional method of 2D photography for ID process. 2. The quality and details of the conventional way 2D photography in ID process is limited and not as robust as 3D scanned image.	Validation of non-ionising 3D scanners on subjects.	Improve quality of forensic evidence preservation.

Domain 6: Information and Communication Technology (ICT) Support Systems for Oral Healthcare				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
Readiness towards 4IR (con't)		3. 3D scan has the capability to turn the image into a 3D figure which may prevent burial site revisit or exhumation that may be costly and cause emotional distress among the family members.		
	9. Non-ionising modalities for oral and maxillofacial diagnosis	1. As x-ray is considered as harmful to human, more exploratory and innovative research is needed to come out with non-ionising modalities that could replace the use of x-ray in diagnosing oral and maxillofacial diseases and conditions. 2. Although MRI and ultrasound have been widely utilised in clinical practice, their use is still low in dentistry due to the cost and lack of experts to manoeuvre and interpret the image in dentistry.	1. Radiomics (AI driven). 2. Cone Beam CT 3D reconstruction algorithms. 3. 3D bioscan printing.	1. Cheap, quick and less costly diagnostic procedures. 2. Precision dentistry. 3. Reduce the dependency on human capital and thus reducing the human bias. 4. Enhance the public trust on governmental healthcare services.

Domain 6: Information and Communication Technology (ICT) Support Systems for Oral Healthcare				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
Readiness towards 4IR (con't)	10. Stereolitography and rapid prototyping using Cone Beam CT 3D reconstruction	1. The use of stereolitography or rapid prototyping have emerged as one of the quickest way to produce biological tissue to replace missing tissues in human such as the cranial bone and mandible. 2. The production of these biological tissues from CBCT 3D reconstruction can be enhanced with more research to gauge the accuracy and precision of the final tissue. 3. In addition, this technology can be coupled with tissue engineering whereby the use of 3D bioscanning can be utilised in managing oral and maxillofacial deformities.	1. 3D printing in dental implants. 2. Tissue engineering in reconstructive surgery.	1. Alternatives to replace costly dental implants. 2. Optimising healing time for reconstructive surgery.

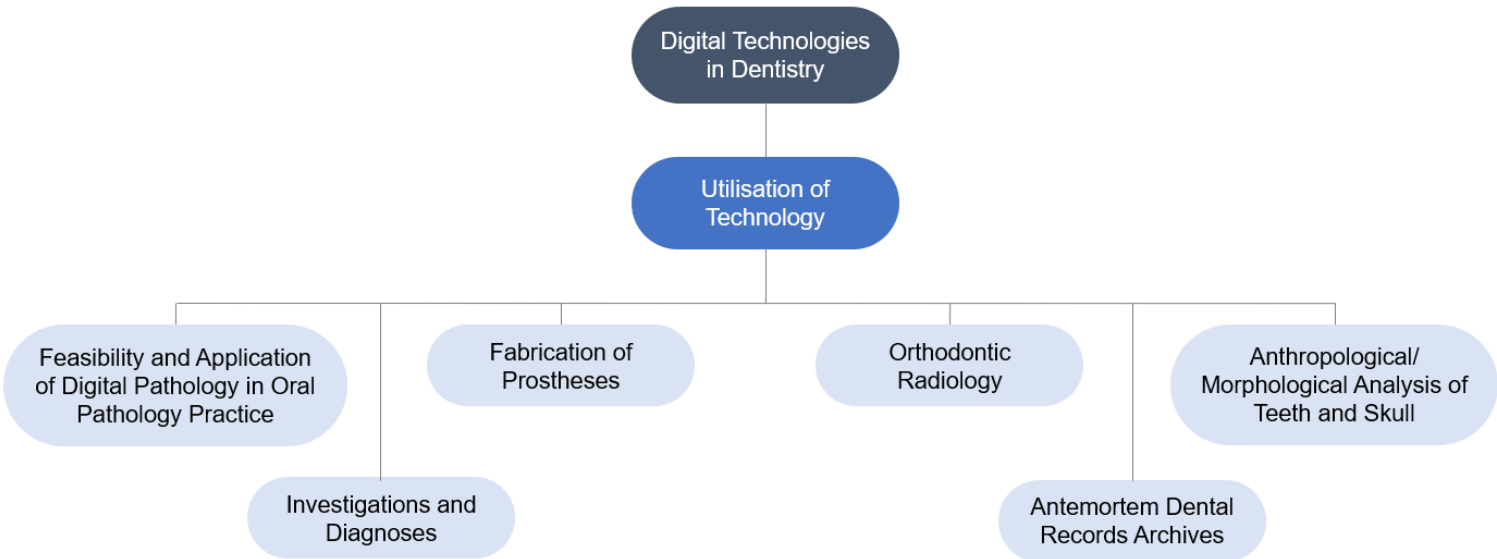
References:

1. Estai M, Kanagasingam Y, Mehdizadeh M, Vignarajan J, Norman R, Huang B, Spallek H, Irving M, Arora A, Kruger E, Tennant M. Teledentistry as a novel pathway to improve dental health in school children: a research protocol for a randomised controlled trial. BMC Oral Health. 2020 Dec;20(1):1-9
2. Rajendran S., et al. Image collection and annotation platforms to establish a multi-source database of oral lesions. Oral Dis. 2022 Apr 10. doi:10.1111/odi
3. Rajendran S., et al. Accelerated implementation of teleconsultation services for the monitoring of oral potentially malignant as a result of the COVID-19 pandemic. Oral Oncol. 2022 Mar;126:105730
4. R.A. Welikala, et al. Clinically guided trainable soft attention for early detection of oral cancer. 2021. The 19th International Conference on Computer Analysis of Images and Patterns (CAIP). Computer Analysis of Images and Patterns. pp 226-236
5. Lim J.H. et al. D'OraCa: Deep Learning-based Classification of Oral Lesion with Mouth Landmark Guidance for Early Detection of Oral Cancer. 25th UK Conference on Medical Image Understanding and Analysis (MIUA2021)
6. Mohammad, N., Muad, A.M., Ahmad, R., Yusof, M.Y.P.M. Accuracy of advanced deep learning with tensorflow and keras for classifying teeth developmental stages in digital panoramic imaging. BMC Medical Imaging. 2022;22(1):66
7. Mohammad, N., Ahmad, R., Muad, A.M., Yusof, M.Y.P.M. Reclassification of Demirjian's Mandibular Premolars Staging for Age Estimation based on Semi-Automated Segmentation of Deep Convolutional Neural Network. Forensic Imaging. 2021 March: 24:200440
8. Rizwal, A.A., Azahar, N., Reduwan, N.H., Yusof, M.Y.P.M. Superimposed polygonal approximation analysis comparing 2D photography and 3D scanned images of bite marks on human skin. Egyptian Journal of Forensic Sciences 2021, 11(1):18

DOMAIN 7

DIGITAL TECHNOLOGIES IN DENTISTRY

Framework for Domain 7: Digital Technologies in Dentistry



Domain 7: Digital Technologies in Dentistry				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
Utilisation of technology	1. Feasibility and application of digital pathology (DP) in oral pathology practice	1. DP is a sub-field of pathology that focuses on data management based on information generated from digitised specimen slides. DP has been approved by the FDA for primary diagnosis. The field of DP has applications in diagnostic medicine, with the goal of achieving efficient and cheaper diagnoses, prognosis and prediction of diseases. 2. The whole-slide imaging (WSI) was shown to be non-inferior to microscopy across a wide range of surgical pathology specimens, sample types and stains. WSI is a strong choice for discussion and collaboration between multiple remote pathologists when it comes to real-time telepathology applications. 3. DP in diagnostics is an emerging and upcoming field. DP also has been proven to show significant outcome during pandemic COVID-19 when pathologists cannot travel for consultation. 4. Digital slides can be easily shared, increasing the potential for data usage in education as well as in consultations between expert pathologists. 5. Apart of commonly used for educational purposes and diagnostic purposes, DP also can be utilised for collaborative research study between centres as study samples can easily be shared between centres.	1. Validation of this method in Malaysia between multicentre for telepathology and teleconsultation. 2. Study the effectiveness of DP in diagnostic accuracy. 3. Provide evidence for best practices framework for DP.	The strongest return on investment (ROI) justification includes improved quality of healthcare, increased efficiency for pathologists and reduced costs in long term.

Domain 7: Digital Technologies in Dentistry				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
Utilisation of technology (con't)	2. Investigations and diagnoses. 3. Fabrication of prostheses.	Computer Aided Design & Computer Aided Manufacturing (CAD CAM) technologies now are a necessity in daily dental work. More technologies from other industries have been borrowed and customised for dental and medical purposes. There are still large rooms for further improvement and exploration.	1. Demonstrate RDITN (restorative dental index of treatment needs) for referral. 2. Classification of restorability. 3. Synthesis new digital technologies for tooth wear/ tooth surface loss. 4. Predict and relate treatment failures and its management. 5. Plan and formulate the maintenance phases. 6. Perio – endo lesions. 7. Maxillofacial prosthodontics. 8. Dental trauma . 9. Sport dentistry. 10. Efficacy & cost effectiveness of new technologies.	1. Synthesis and compare new technologies assessments: • Analyse cost effectiveness; • Evaluate patient and user reported outcome; • Summarise and conclude software evaluation. 2. Demonstrate, appraise and critique patients' and clinical data (big data) in relation to new digital technologies.

Domain 7: Digital Technologies in Dentistry				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
Utilisation of technology (con't)	4. Orthodontic radiology.	Radiographic examinations like OPG, Lateral Cephalograms and increasingly now the use of cone beam CT (CBCT) is very popular in orthodontics. Concerns of poor guidelines to use these special investigations may lead to increased and unnecessary radiation dosage without valuable diagnostic yield. Studies[1,2] show that CBCT was more feasible in the localisation of impacted teeth, detecting canine apices, lateral root resorption, and dilaceration compared to 2D radiographs. Therefore, it can be hypothesised that CBCT shows better outcome efficacy in complex cases. Also, in some studies, original treatment plans of more than 25 per cent of cases were changed when consulting CBCT images compared to conventional 2D imaging. However, there is still lack of evidence considering optimisation and justification for the use of CBCT in the paediatric population. Current literature[3] also reports moderate to excellent reliability of upper pharyngeal airway assessment using dental CBCT. However, only limited aspects of the process of airway analysis have been evaluated, indicating that further research is required to adequately establish the	1. The use of radiology in orthodontics. 2. Volumetric CBCT studies of the airway, soft tissues and skeletal structures of the dento-facial region. 3. Prevalence of root resorption after orthodontic treatment. 4. The CBCT study/ radiographic study in the effectiveness of growth modification.	1. National guidelines for the use of radiology in orthodontics/ dentistry. 2. Growth studies of the dento-facial region.

Domain 7: Digital Technologies in Dentistry				
Problem Statement	**Research Scope**	**Gaps & Needs (Rationale)**	**Suggested Research Area**	**Expected Output**
Utilisation of technology (con't)		reliability of upper pharyngeal airway assessment of patients using dental CBCT. Also, there is a lack of gold standard using CBCT technology for the segmentation of the nasal airway as well as scientific justification of a solid and optimised CBCT protocol for airway imaging.[4,5,6,7]		
	5. Antemortem dental records archives.	Archival of dental records. There is a lack of national standardisation on dental record keeping database.	Missing person database.	Identification of unknown body related to missing person cases.
		Adherence to standards in dental records management.	Clinical audit.	Increase the percentage of forensic identification through dental means.
		Dental practice and impact to forensic odontology.	Dental/ denture labelling using QR code/ digital tracker – revisited.	
	6. Anthropological/ morphological analysis of teeth and skull.	Population based morphological research.[8]	Predictors/ specific phenotypes - targeted at the region.	Database for profiling unknown remains as part of comprehensive scientific human identification together with other forensic field such as forensic pathology and forensic anthropology.

References:

1. Snehlata Oberoi, Stephanie Knueppel, Three-dimensional assessment of impacted canines and root resorption using cone beam computed tomography, Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology 2012; Volume 113, Issue 2
2. Annelore De Grauwe, Irem Ayaz, Sohaib Shujaat, Simon Dimitrov, Logan Gbadegbegnon, Bart Vande Vannet, Reinhilde Jacobs, CBCT in orthodontics: a systematic review on justification of CBCT in a paediatric population prior to orthodontic treatment, European Journal of Orthodontics 2019; Volume 41, Issue 4, 381–389
3. Jason N Zimmerman, Janson Lee, Benjamin T Pliska, Reliability of upper pharyngeal airway assessment using dental CBCT: a systematic review, European Journal of Orthodontics 2017; Volume 39, Issue 5, 489–496
4. Oberoi, S., Knueppel, S. Three-dimensional assessment of impacted canines and root resorption using cone beam computed tomography. Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology. 113(2):2012
5. De Grauwe, A., Ayaz, I., Shujaat, S., Dimitrov, S., Gbadegbegnon, L., Vannet, B.V., Jacobs, R. CBCT in orthodontics: a systematic review on justification of CBCT in a paediatric population prior to orthodontic treatment. European Journal of Orthodontics. 2019 Aug;41(4):381–389
6. Zimmerman, J.N., Lee, J., Pliska, B.T. Reliability of upper pharyngeal airway assessment using dental CBCT: a systematic review. European Journal of Orthodontics. 2017 Oct;39(5):489–496
7. Ghazali, L., Mohd Yusof, M.Y.P., Norman, N.H. Effects of scanning parameters reduction in dental radiographs on image quality and diagnostic performance: A randomised controlled trial. Journal of Orthodontics. 2021;48(1):5-12.
8. Sigali, W., Khamis, M.F.B., Ashar, A., Samsudin, A.H.Z. Digital Analysis of mental foramen position reveals effects of ethnicity and gender on Malaysian population. J Int Dent Medical Res. 2021;14(1):286-291

CONCLUSION

The Oral Health Research Priorities in Malaysia aims to provide clear guidance for oral health research activities towards generating useful evidence that is relevant to the national health priorities. Oral health fraternity, individual as well as healthcare organisations are urged to refer to the outlined research priority areas when planning and designing their researches. These research priorities are applicable to all institutions that conduct oral health researches in Malaysia including the Ministry of Health, universities, Ministry of Defence, dental industries, oral health community along with the dental students.

The research priorities stipulated in this document shall be the key focus for oral health research in the next few years, depending on the pace of the profession's evolution, national oral health priority setting and global challenges in oral health services. The National Oral Health Research Initiative (NOHRI) will continue to be vigilant on the relevance and applicability of these priority areas. Whenever necessary, the Oral Health Research Priorities in Malaysia will be reviewed accordingly, incorporating new domains that may emerge in the future.

ACKNOWLEDGEMENT

The secretariat would like to express our appreciation to the Chairperson of National Oral Health Research Initiative (NOHRI) and Executive Members of NOHRI for their continuous support in setting the Oral Health Research Priorities in Malaysia. We would also like to thank all the members of the Technical Working Group on Oral Health Research, all stakeholders and everyone who have contributed in the publication of this document.

e ISBN 978-629-98561-3-9